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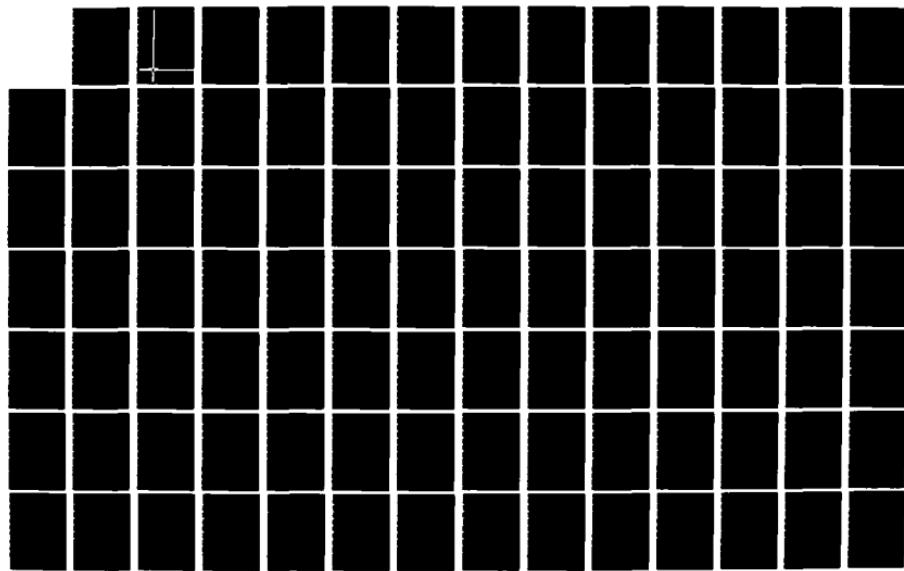
POWER CONDITIONING EQUIPMENT AVAILABILITY SURVEY(U)
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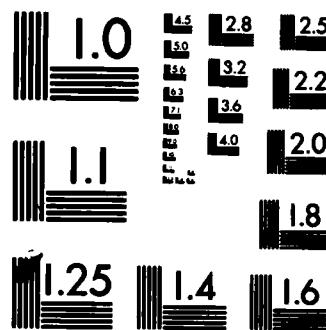
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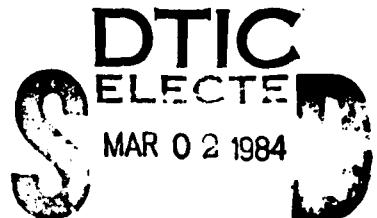
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Report 2395

POWER CONDITIONING EQUIPMENT AVAILABILITY SURVEY

by
W. David Lee

December 1983



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United States Army
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Fort Belvoir, Virginia 22060

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SUMMARY

A survey of the power conditioning market has been conducted to determine the availability and characteristics of electrical power conditioning equipment, both solid state and rotating. Sources for the survey were sought through synopsis in the Commerce Business Daily as well as direct mail requests and contacts with Belvoir Research and Development Center Foreign Liaison Offices and foreign embassies. The survey was conducted by means of a questionnaire furnished to prospective sources. Data from the survey are summarized in this report. The survey data show that general purpose, multifrequency, multivoltage power conditioners are not presently available. Most single-frequency-in, single-frequency-out combinations of standard voltage and connections are supported, however. Few units are designed for the military environment, and little attention has been devoted to minimizing size and weight.

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POWER CONDITIONING EQUIPMENT

AVAILABILITY SURVEY

I. BACKGROUND

A TRADOC/DARCOM Letter of Agreement (LOA) for a Family of Military Power Conditioners established a requirement and an operational concept for the use of electrical power conditioners by Army field units. This LOA is included as Appendix A of this report. The family of power conditioners as envisioned by the LOA would consist of eight units in ratings from 1.5 kW to 200 kW, coinciding with the ratings of the DOD standard family of Mobile Electric Power Sources. The units would be used to condition power for tactical systems, supply uninterruptible power as required, and to supply general purpose power in semi-fixed locations from sources of incompatible power. They would be capable of voltage and frequency conversion as well as upgrading of power quality. As one step in the definition of a program to provide this capability, Belvoir Research and Development Center has been requested by DOD Project Manager-Mobile Electric Power (PM-MEP) to identify the types and characteristics of power conditioning equipment available on the commercial market for potential procurements as Military-adapted commercial items or as non-development items within the range of ratings stated.

II. OBJECTIVES

This survey of the commercial market has been conducted to determine the availability of power conditioning equipment and to compare characteristics of that equipment with requirements of the LOA. It encompasses all types of power conditioning equipment: converters, inverters, frequency changers, line conditioners and uninterruptible power supplies. Both rotating and solid state equipment are included. The following functional definitions of equipment types are used within this report: (1) *converters* accept a.c. or d.c. input and provide d.c. output; (2) *inverters* accept d.c. input and provide a.c. output; (3) *frequency changers* accept input at one or more a.c. frequencies and provide output at one or more different a.c. frequencies; (4) *line conditioners* accept a.c. input and provide a.c. output at the same frequency with enhanced voltage regulation of the line and transient or noise suppression; (5) *uninterruptible power supplies* (UPS) provide no-break power from a separate a.c. or d.c. energy source during disruption of the primary supply.

III. APPROACH

The survey was undertaken by means of a questionnaire sent to prospective sources. A copy of the questionnaire is included as Appendix B and a copy of the cover letter, as Appendix C. Sources were sought through a synopsis published in the Commerce Business Daily (CBD) on 17 December 1982. A copy of the synopsis is included as Appendix D. In addition to those sources responding to the CBD synopsis, copies of the questionnaire were sent to companies otherwise known to be active in the field. Contacts were also made through the Belvoir Research and Development Center Liaison Offices for possible sources in Australia, Britain, Canada, France and Germany. A list of sources to whom the questionnaire was sent is included as Appendix E.

Responses to the questionnaire were used in assembling this report. In some cases, companies provided brochures or product data sheets in addition to or instead of the questionnaire. In those cases, information was transferred where possible to the questionnaire format for use in analyzing responses. The citation of manufacturers and trade names of commercially available products does not constitute official endorsement or approval of the use of such products. Every effort has been made to report accurately the data furnished. However, no liability is assumed.

The questionnaire solicits information concerning technical performance of the equipment and its availability and cost. A brief summary follows:

Section 1 asks for the manufacturer's name.

Section 2 requests data on the basic configuration of the equipment such as input/output connections, frequency, power, size and weight, and UPS capability.

Section 3 asks for the technology(ies) utilized. It is intended to determine general techniques and components such as the use of SCRs or transistors, step wave inverters, ferroresonant transformers, high frequency switching, etc., rather than proprietary details of the equipment design.

Section 4 requests electrical performance specifications with regard to voltage and frequency regulation and modulation, harmonic distortion, and phase relationships.

Section 5 requests limitation of the equipment with respect to outside effects such as load power factor, short circuit, and fluctuations at the input line.

Section 6 asks for ambient operating conditions including temperature and elevation limits, electromagnetic and nuclear radiation hardness, and protection against an outdoor environment.

Section 7 requests information on operation, reliability and maintainability and requests such data as efficiency, noise level, MTBF, and use of high reliability parts.

Section 8 requests information on controls, instrumentation and protection, and conformance to safety standards.

Section 9 requests cost and production data.

IV. RESULTS

The results of this survey are presented in the form of tables listing selected data for each model of power conditioning equipment reported, as discussed below. A concerted effort has been made to obtain information on all power conditioning equipment currently in production and being marketed.

In the process of gathering the data in this report, 58 U.S. and 17 foreign companies were queried (see Appendix E). Information obtained from the respondents encompasses more than 460 models of power conditioning equipment. The responding companies and the reported items of equipment are considered to be a good representation of the power conditioning field at this time as to the range of cost, size, weight, environmental factors, voltages, frequencies, and electrical performance.

For the purposes of this report, power conditioning equipment has been separated into the following functional categories as defined in Section II: UPS, Frequency Changers, Inverters, Converters, and Line Conditioners. Within these categories, units are grouped by power rating into four ranges: 0 kW to 5 kW, 5 kW to 15 kW, 15 kW to 60 kW, and greater than 60 kW.

V. DATA

Selected data for each model are reported in Tables 1 through 5. The tables present characteristics of the equipment which are considered most important for military applications. In addition to company name and model designation, the characteristics include: input and output voltage, frequency and phase, size and weight, output voltage regulation, frequency regulation and total harmonic distortion, and environmental tolerances. The data shown are as provided by the sources. In cases where data sheets were furnished instead of completed questionnaires, data were extracted from the sheets. Blanks indicate that the data were not provided. Unless otherwise specified, dimensions are in

inches and weight in pounds. In cases where more than one input or output voltage is shown as being available, the word "or" indicates that a selection may be made when specifying the unit; "and" indicates that the combination is furnished on the unit as delivered. Power rating is given in kVA. Most units allow for at least 0.8 power factor, lagging.

1. Line Conditioners (Table 1). Line conditioners are used primarily for transient and electrical noise suppression and for a degree of voltage regulation of input power to sensitive equipment. These functions are accomplished through such techniques as filtering, use of transient energy absorbers (MOVs, Transorbs, etc.), and ferroresonant and step-changing transformers. No control of frequency (or frequency changing) is provided. The models reported are not designed for rough handling or harsh environments.

LINE CONDITIONERS
 $0 < P \leq 5\text{kW}$

Table 1.

Company	Gould	Gould	
Model	DLC 306X	DLC 506X	
Rating			
Input	3.0 kVA	5.0 kVA	
Output	96-260v (depending on model), 1 phase, 60Hz	96-260v (depending on model), 1 phase, 60Hz	
Size	120 or 120/240v, 60Hz 20 x 16.5 x 13.25H	120 or 120/240v, 60Hz 20 x 16.5 x 13.25H	
Weight	(0.84 ft ³ /kVA) 300 lb	(0.5 ft ³ /kVA) (100 lb/kVA)	
Voltage Req	3%	3%	
Frequency Regulation			
Harmonic Distortion	5% (output)	5% (output)	
Environment	0°C to 40°C	0°C to 40°C	

X = number specifying voltage range and connections

Table 1 (Continued).

Company	Gould	Gould	Gould
Model	DLC 756X	DLC 1006X	DLC 1506X
Rating	7.5 kVA	10.0 kVA	15 kVA
Output	96-260V (depending on model), 60Hz	96-260V (depending on model), 60Hz	208 or 480V 3 phase, 60Hz
Weight	120v or 120/240 C.T., 60Hz	120v or 120/240 C.T., 60Hz	120v or 120/240 C.T. or 120/208, 60Hz
Size	21.38 x 35.38 x 32.5	21.38 x 35.38 x 32.5	28.75 x 24 x 61.5
Model	(1.87 ft ³ /kVA)	(1.4 ft ³ /kVA)	(1.6 ft ³ /kVA)
Weight	600 lb	950 lb	1550 lb
Output	(80 lb/kVA)	(95 lb/kVA)	(103 lb/kVA)
Size	38	38	38
Frequency Regulation			
Harmonic Distortion	5% (output)	5% (output)	5% (output)
Environment			0-40°C
			0-40°C

2. Inverters (Table 2.). Inverters are used to develop an a.c. output from a d.c. source. (Thus, solid state UPS systems and frequency changers typically include an inverter section.) The inverters reported in this group are configured as stand-alone systems. Included in the group are units designed for aircraft power systems and fuel cell and solar photovoltaic systems. Weight to power ratios are shown in Figure 1.

The aircraft inverter technology appears promising. At the 1-kVA level, Avionic Instruments produces 50-Hz, 60-Hz and 400-Hz models (Nos. 3A1000, 2A1000, and 1B1000, respectively) with weight to power ratios of about 13 lb/kVA. These units are rated for a wide temperature range (-55°C to +71°C) and for high altitude (55,000 ft) operation. Voltage and frequency regulation of the 3A1000 model are within the precise power definition of MIL-STD-1332. As manufactured and distributed, each of the Avionic Instruments units provide only single-frequency/single-voltage output. Leland, also, has models with weight to power ratios in the 13 lb/kVA to 17 lb/kVA range at ratings of 1 kVA to 3 kVA which have operating temperature ranges of -55°C to +71°C and altitude to 55,000 ft. Bendix Model 32827-10 is a motor-generator (MG) type inverter with a weight to power ratio of 15 lb/kVA and an operating temperature of -55°C to +85°C.

Aerospace Avionics Model SVS 500 (0.5 kVA) has 60-Hz and 400-Hz output but with a narrower temperature range (0°C to 50°C). DECC Model 61098 has a weight to power ratio of 29 lb/kVA with 60-Hz and 400-Hz output. This model was specifically developed for the MERADCOM fuel cell program. The Powertronics unit has variable output frequency but is part of a system and is not available as a separate unit.

INVERTERS
 $0 < P \leq 5\text{kW}$

Table 2.

Company	Aerospace Avionics	Aerospace Avionics	Aerospace Avionics	Aerospace Avionics
Model	SV 100	SV 250	SVS 500	Multiple inverter system
Rating	0.1kVA	.25kVA	0.5kVA	.6kVA 4kVA .1kVA
Input	17-35v DC	9-36v DC	20-28vDC	25-32v DC 25-32v DC 25-44v DC
Output	115VAC 1 phase, 400Hz	115VAC 1 phase, 400Hz	115VAC, 1 phase 60 or 400Hz	120VAC 400Hz 120VAC 60Hz 24VAC 400Hz
Size	4.5 x 7 x 5H (0.91 ft ³ /kVA)	9 1/4 x 4 3/4 x 5 1/4H (0.53 ft ³ /kVA)		16 x 14x 14H
Weight	4.7 lb (47 lb/kVA)	10 lb (40 lb/kVA)		
Voltage Reg	1%	1%	1%	2%
frequency Regulation	1%	0.1%	2%	1%
Harmonic Distortion	5%	3%	3%	3%
Environment		-54 to +85°C 65000 elevation	0-50°C Drip-proof	0-35°C Drip-proof

INVERTERS
 $0 < P \leq 5\text{kW}$

Table 2. (Continued).

Company	Aerospace Avionics	Aerospace Avionics	DECC	DECC
Model	SV 1000	1.5kVA inverter	61098	61233
Rating	1kVA	1.5kVA	1.5kW	5kW
Input				
Output	9-36VDC	205-320VDC	36-70VDC	170-300VDC
Size	11 1/2 x 5 1/2 x 8H	120VAC 60Hz	Selectable 120 or 240, 60 or 400Hz 19.5 x 8.5 x 8.5H	115v and 115 or 230v
Weight	23 lb	(0.29 ft ³ /kVA)	(0.43 ft ³ /kVA) 54 lb	
Voltage Reg	(23 1b/kVA)	28	(29 1b/kVA) 28	
Frequency Regulation	0.1%	1%	0.5Hz	
Harmonic Distortion	5%	5%	3% (output)	
Environment				
	-54 to +85°C 65000 elevation	0-55°C		

INVERTERS
 $0 < P \leq 5\text{kW}$

Table 2. (Continued).

Company	Avionic Instruments	Avionic Instruments	Avionic Instruments	Avionic Instruments
Model				
1AI25	2AI25	3AI25	3AI250	
Rating	.125kVA	.125kVA	.125kVA	.25kVA
Input				
	20 - 37 VDC			
Output				
	115 VAC, 26 VAC 400Hz	115 VAC, 60Hz	115 VAC, 220 VAC 50Hz	115 VAC, 220 VAC 50Hz
Size				
Weight	4.0 lb	4.0 lb	4.0 lb	4.5 lb
	(32 lb/kVA)	(32 lb/kVA)	(32 lb/kVA)	(18 lb/kVA)
Voltage Reg	1%	1%	1%	1%
Frequency Regulation				
Harmonic Distortion	.5%	.5%	.5%	.5%
Environment				
	-55 to 71°C 95%RH 55,000 ft			

INVERTERS
 $0 < P \leq 5\text{kw}$

Table 2. (Continued).

Company	Avionic Instruments	Avionic Instruments	Avionic Instruments	Avionic Instruments
Model				1BI000 - ()
1B250	2A250	2A1000 - ()	\$4250	(\$4.25/kVA)
Rating				
Input	.25kVA	.25kVA	1kVA	1kVA
Output	20 - 37 VDC			
Size	115 VAC, 26 VAC 400Hz	115 VAC, 60Hz	115 VAC, 60Hz	115 VAC, 26 VAC 400Hz
Weight	4.5 lb	4.5 lb	12.5 lb	12 x 8.5 x 4H
Voltage Reg	(18 lb/kVA)	(18 lb/kVA)	(12.5 lb/kVA)	(0.24 ft ³ /kVA)
Frequency Regulation	1%	1%	2%	(0.24 ft ³ /kVA)
Harmonic Distortion	.5%	.5%	1%	13.5 lb
Environment	-55 to 71°C 95%RH 55,000 ft			

INVERTERS
 $0 < P \leq 5\text{kW}$

Table 2. (Continued).

Company	Avionic Instruments	Avionic Instruments	Elgar Corp	Bendix Corp
Model	1B800 - ()	3A1000 - ()	INV-502	32B27-10 (MG)
Rating	.8kVA	1kVA	5kVA	5kVA
Input	20 - 37 VDC	20 - 37 VDC	105 - 140 VDC	28VDC
Output				
Size	12 x 8.5 x 4H (0.295 ft ³ /kVA)	115 VAC, 26 VAC 400Hz (0.236 ft ³ /kVA)	115 VAC, 220 VAC 50Hz (0.236 ft ³ /kVA)	120 VAC 19 x 37 x 72H (5.86 ft ³ /kVA)
Weight	13.5 lb (16.9 lb/kVA)	12.5 lb (12.5 lb/kVA)	850 lb (170 lb/kVA)	75 lb (15 lb/kVA)
Voltage Reg	2%	1%	2%	
Frequency Regulation	1%	1%	0.25%	
Harmonic Distortion	1%	.5%	5%	
Environment	-55 to 71°C 95%RH 55,000 ft	-55 to 71°C 95%RH 55,000 ft	0 to 40°C	-55 to 85°C

INVERTERS
 $0 < P \leq 5\text{kW}$

Table 2. (Continued).

Company	Jet Electronics and Technology Inc. (J.E.T.)	Jet Electronics and Technology Inc. (J.E.T.)	Jet Electronics Technology Inc. (J.E.T.)	Jet Electronics Technology Inc. (J.E.T.)
Model	SI 125DA	SI 1500A	SI 1000B	SI 2500B
Rating	1.25kVA	1.5kVA	1kVA	2.5kVA
Input	24-30v DC	21-36.4v DC	24-30v DC	20-30v DC
Output				
Size	10.5 x 5.43 x 7.69H (0.20 ft ³ /kVA)	10.5 x 5.43 x 7.69H (0.17 ft ³ /kVA)	115VAC 1 phase, 400Hz (0.13 ft ³ /kVA)	115VAC 1 phase, 400Hz (0.20 ft ³ /kVA)
Weight	24 lb (19.2 lb/kVA)	23.5 lb (15.7 lb/kVA)	14.6 lb (14.6 lb/kVA)	45 lb (18.0 lb/kVA)
Voltage Reg	3%	+3% -3%	3%	+3%
Frequency Regulation:	1%	+1%	1%	+1%
Harmonic Distortion	5%	5%	5%	6%
Environment	-55 to 85OC 55000 ft @ 30OC	-55 to 85OC 55000 ft @ 25OC	-55 to 71OC 51000 ft @ 20OC	-55 to 71OC 50000 ft

INVERTERS
 $0 < P \leq 5\text{kW}$

Table 2. (Continued).

Company	Jet Electronics and Technology Inc. (J.E.T.)	Jet Electronics and Technology Inc. (J.E.T.)	Elgar Corp	Elgar Corp
Model	SI 3000A	SI 3003	INV-1C2	INV-252
Rating	3.0kVA	3.0kVA	1kVA	2.5kVA
Input	20-36v DC	24-32v DC	105-140vDC	105-140vDC
Output				
Size	115VAC 1 phase, 400Hz 13 x 7 x 9.53H	115VAC 3 phase, 400Hz 13 x 7 x 9.5H	120VAC 19 x 19 x 12.25H	120VAC 19 x 19 x 14H
Weight	(0.167 ft ³ /kVA) 49 lb	(0.167 ft ³ /kVA) 55 lb	(2.56 ft ³ /kVA) 190 lb	(1.17 ft ³ /kVA) 230 lb
Voltage Reg	(16.3 10/kVA) $\pm 3\%$	(18.3 10/kVA) $\pm 2.5\%$	(190 ib/kVA) 28	(92 lb/kVA) 28
Frequency Regulation	$\pm 0.1\%$	$\pm 0.1\%$	0.25%	0.25%
Harmonic Distortion	6%	5%	5%	5%
Environment	-55°C to +71°C 50000 ft	-55°C to 71°C	0 to 40°C	0 to 40°C

INVERTER
 $0 < P \leq 5\text{kW}$

Table 2. (Continued).

Company	Flite-Tronics PC 15H	Flite-Tronics PC 16	Flite-Tronics PC 17	Flite-Tronics PC 17A
Model	\$1290 (\$4.30/VA)	\$1295 (\$5.18/VA)	\$1050 (\$3.08/VA)	\$1975 (\$2.63/VA)
Rating	.30kVA	.25kVA	.6kVA	.75kVA
Input	28VDC	28VDC	28VDC	28VDC
Output				
Size	10 5/8 x 6 x 3 7/32H (0.396 ft ³ /kVA)	12 x 7.5 x 4H (0.833 ft ³ /kVA)	12 x 8 1/2 x 4 1/12H (0.40 ft ³ /kVA)	12 x 8 1/2 x 4 1/16H (0.32 ft ³ /kVA)
Weight	8.1 lb (27 lb/kVA)	15 lb 5 oz (61.2 lb/kVA)	14 lb (23.3 lb/kVA)	15.6 lb (20.8 lb/kVA)
Voltage Req				
Frequency Regulation	3 to 7%		3 to 7%	3 to 7%
Harmonic Distortion				
Environment	-65 to 160°F 95%RH 45,000 ft	-10 to 160°F 45,000 ft	-65 to 160°F 95%RH 45,000 ft	-65 to 160°F 95%RH 45,000 ft

INVERTER
 $0 < P \leq 5\text{kW}$

Table 2. (Continued).

Company	Flite-Tronics PC 50	Flite-Tronics PC 125	Flite-Tronics PC 250	Flite-Tronics PC 251
Model	\$695 (\$13.90/VA)	\$875 (\$7.00/VA)	\$1250 (\$5.00/VA)	\$1295 (\$5.18/VA)
Rating	.05 kVA	.125 kVA	.25 kVA	.25 kVA
Input	20 - 37VDC	20 - 37VDC	20 - 37VDC	18 - 37VDC
Output				
Size	7 x 4 9/16 x 2 3/4H (1.02 ft ³ /kVA)	7 x 5.1 x 2.75H (0.455 ft ³ /kVA)	9.39 x 6 x 3.23H (0.421 ft ³ /kVA)	7 x 5 x 2.75H (0.223 ft ³ /kVA)
Weight	4.3 lb	5.1 lb	8.1 lb	5 lb
Voltage Reg				
Frequency Adjustment				
Harmonic Distortion	3%	3%	3.5%	4%
Environment	-67 to 160°F 95%RH 50,000 ft	-67 to 160°F 95%RH 50,000 ft	-67 to 160°F 95%RH 50,000 ft	-67 to 160°F 95%RH 50,000 ft

INVERTER
 $0 < P \leq 5\text{kW}$

Table 2. (Continued).

Company	Flite-Tronics	Flite-Tronics	KGS Electronics	KGS Electronics
Model	PC 350	PC 450	SPC 5	SPC 10
Rating	\$1,425 (\$4.07/kVA)	\$1635 (\$3.63/kVA)		
Input		.45 kVA	.05 kVA	.10 kVA
Output	20 - 37VDC	20 - 37VDC	20 - 36VDC	22 - 32VDC
Size	26 or 115VAC, 400Hz	26 or 115VAC, 400Hz	26 or 115VAC, 400Hz	26 or 115VAC, 400Hz
	9.39 x 6 x 4.13H	9.39 x 6 x 4.13H	6.5 x 4.12 x 2.75H	8.25 x 4.5 x 3.55H
Weight	(0.365 ft ³ /kVA)	(0.299 ft ³ /kVA)	(0.852 ft ³ /kVA)	(0.763 ft ³ /kVA)
	6.75 lb	9.9 lb	3 lb	5.2 lb
Voltage Range	(25 lb/kVA)	(22 lb/kVA)	(60 lb/kVA)	(52 lb/kVA)
frequency Regulation				
harmonic Distortion	4%		3 to 7%	3 to 7%
Environment				
	-67 to 160°F 50,000 ft	-67 to 160°F 50,000 ft	-65 to 160°F 95%RH 45,000 ft	-65 to 160°F 95%RH 45,000 ft

INVIER
 $G < P \leq 5kW$

Table 2. (Continued).

Company	KGS Electronics	KGS Electronics	KGS Electronics	KGS Electronics
Model	SPC 30	SPC 38	SPC 60	SPC 60B
Rating	.3kVA	.375kVA	.6kVA	.6kVA
Input	28VDC	20 - 37VDC	22 - 36VDC	22 - 36VDC
Output				
Size	10 x 6 x 3 7/32H	10 x 6 x 3 5/8H	11 1/4 x 7 3/4 x 4H	11 1/4 x 7 3/4 x 4H
	(0.373 ft ³ /kVA)	(0.336 ft ³ /kVA)	(0.336 ft ³ /kVA)	(0.336 ft ³ /kVA)
Weight	8.1 lb	8.8 lb	14 lb	14 lb
Voltage Req	(27 lb/kVA)	(23.5 lb/kVA)	(23.3 lb/kVA)	(23.3 lb/kVA)
Frequancy Regulation				
Harmonic Distortion	3 to 7%	2 to 5%	< 7%	< 7%
Environment	-65 to 160°F 95%RH 45,000 ft	-65 to 160°F 95%RH 50,000 ft	-65 to 160°F 95%RH 45,000 ft	-65 to 160°F 95%RH 45,000 ft

INVERTER
 $0 < P \leq 5\text{kW}$

Table 2. (Continued).

Company	KGS Electronics	KGS Electronics	KGS Electronics	KGS Electronics
Model	SPC 75	SPS 205	SPS 206	SPS 305
Rating	.75kVA	.75kVA	.75kVA	.75kVA
Input	26 to 37VDC	28VDC	28VDC	28VDC
Output				
Size	12 x 8 x 4H (0.296 ft ³ /kVA)	115VAC, 50Hz (1.04 ft ³ /kVA)	115VAC, 60Hz (1.04 ft ³ /kVA)	115VAC, 50Hz (0.772 ft ³ /kVA)
Weight	14 lb (18.7 lb/kVA)	15.7 lb (17.5 lb/kVA)	15.7 lb (18.5 lb/kVA)	18 lb (16.7 lb/kVA)
Voltage Reg.				
frequency Reproduction				
harmonic Distortion	2 to 5%	< 7%	< 7%	< 7%
Environment				
	-65 to 100°F 95%RH 50,000 ft	-65 to 160°F 95%RH 45,000 ft	-65 to 160°F 95%RH 45,000 ft	-65 to 160°F 95%RH 45,000 ft

Table 2. (Continued).

Company	KGS Electronics	KGS Electronics	KGS Electronics	KGS Electronics
Model	SPS 306	SPS 306B	SPS 1307	SPS 2052
Rating	.375VA	.375kVA	1.3kVA	.20kVA
Input	28VDC	28VDC	28VDC	28VDC
Output				
Size	12 x 7 1/2 x 4H	115VAC, 60Hz	115VAC, 60 to 64Hz	230VAC, 50Hz
	(0.694 ft ³ /kVA)	12 x 7 1/2 x 4H	14 x 7 3/4 x 4H	12 x 7 1/2 x 4H
Weight	18 lb	(0.556 ft ³ /kVA)	(0.193 ft ³ /kVA)	(1.04 ft ³ /kVA)
	(60 lb/kVA)	18 lb	24.5 lb	15.7 lb
Voltage Req		(48 lb/kVA)	(18.8 lb/kVA)	(78.5 lb/kVA)
Frequency Regulation				
Harmonic Distortion	< 7%		< 7%	< 7%
Environment	-65 to 160°F 95%RH 45,000 ft	-65 to 160°F 45,000 ft	-65 to 160°F 55,000 ft	-65 to 160°F 45,000 ft

INVERTER
 $0 < P \leq 5\text{kw}$

Table 2. (Continued).

Company	KGS Electronics	KGS Electronics	KGS Electronics	KGS Electronics
Model	SPS 3052	SPS 3062	SPS 3063	SPS 3163
Rating	• 7 kVA	• 3kVA	• 3kVA	• 3kVA
Input				
Output	28VDC	28VDC	28VDC	28VDC
Size	12 x 7 1/2 x 4H (0.772 ft ³ /kVA)	12 x 7 1/2 x 4H (0.694 ft ³ /kVA)	12 x 7 1/2 x 4H (0.694 ft ³ /kVA)	12 x 7 1/2 x 4H (0.694 ft ³ /kVA)
Weight	18 lb (66.7 lb/kVA)	18 lb (60.0 lb/kVA)	18 lb (60.0 lb/kVA)	18 lb (60.0 lb/kVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion	< 7%	< 7%	< 7%	< 7%
Environment				
	-65 to 160°F 45,000 ft			

INVERTER
 $0 < P \leq 5 \text{ kW}$

Table 2. (Continued).

Company	Nova Electric	Bendix Corp.	Bendix Corp	Bendix Corp
Model				
Rating	5K-3/6-XX	32B50-15 (MC)	39B168-1	32B180-2 (MG)
Input	48 or 120 VDC	11.25 kVA	6.5 kVA	0.75 kVA
Output				
Size	24 x 17 x 42H	115 or 230 VAC, 3 phase, 50 or 60 or 400 Hz	115 VAC, 1 phase, 400 Hz	115 VAC, 3 phase, 400 Hz
Weight	416 lb	9.25 x 4.5 x 6.25H (1.98 ft ³ /kVA)	14.75 x 7.5 x 6.75H (0.602 ft ³ /kVA)	11.5 x 5.25 x 7.25H (0.338 ft ³ /kVA)
Voltage Reg	1%			
frequency Regulation	0.15%			
Harmonic Distortion	5%			
Environment				
	-20 to 50°C	-55 to 85°C	-65 to 71°C	-55 to 85°C 50000 ft

X denotes input voltage

INVERTER
 $0 < P \leq 5 \text{ kW}$

Table 2. (Continued).

Company	Leland	Leland	Leland	Leland
Model	ASH584-1	ASH671-1	ASH584-2	ASH674-1
Rating				
Input	0.25 kVA	0.25 kVA	0.3 kVA	0.4 kVA
Output	24 to 32 VDC	20 to 32 VDC	24 to 32 VDC	24 to 32 VDC
Size	9.25 x 4.75 x 5H (0.509 ft ³ /kVA)	10.63 x 5.25 x 3.13H (0.404 ft ³ /kVA)	9.25 x 4.75 x 5H (0.424 ft ³ /kVA)	10.62 x 6.02 x 3.64H (0.337 ft ³ /kVA)
Weight	7.3 lb (29.2 lb/kVA)	5.6 lb (22.4 lb/kVA)	7.5 lb (25.0 lb/kVA)	7.3 lb (18.2 lb/kVA)
Voltage Reg				
Frequency Regulation				
harmonic Distortion	5%	4%	4%	4%
Environment	-55 to 71°C 55000 ft	-55 to 71°C 55000 ft	-55 to 71°C 55000 ft	-55 to 71°C 55000 ft

INVERTER
 $0 < P \leq 5 \text{ kW}$

Table 2. (Continued).

Company	Leland	Leland	Leland
Model			
ASH564-B-2	ASH564-B-6	ASH664-1	ASH574A2
Rating			
0.8 kVA	1 kVA	1.5 kVA	2.5 kVA
Input			
24 to 32 VDC	24 to 32 VDC	20 to 32 VDC	20 to 32 VDC
Output			
	26 or 115 VAC 1 phase, 400 Hz	26 or 115 VAC 1 phase, 400 Hz	26 or 115 VAC 1 phase, 400 Hz
Size	12 x 8.5 x 4H	12 x 8.5 x 4.06H	12.5 x 7.52 x 6H
	(0.295 ft ³ /kVA)	(0.240 ft ³ /kVA)	(0.218 ft ³ /kVA)
Weight	13.8 lb	14.8 lb	25.5 lb
	(17.2 lb/kVA)	(14.8 lb/kVA)	(17.0 lb/kVA)
Voltage Reg			
Frequency Regulation			
Harmonic Distortion	4%	4%	5%
Environment			
	-55 to 71°C 55000 ft	-55 to 71°C 55000 ft	-55 to 71°C 55000 ft

Table 2. (Continued).

Company	Leland	Nova Electric	Nova Electric	Nova Electric
Model	ASR574A4	1260XX	12400XX	2560XX
Rating	5 kVA	0.145 kVA	0.125 kVA	0.25 kVA
Input	20 to 32 VDC	12 or 24 or 48 or 120 VDC	12 or 24 VDC	12 or 24 or 48 or 120 VDC
Output				
Size	26 or 115 VAC 1 phase, 400 Hz 13.1 x 7.52 x 9.56H	115 or 230 VAC 1 phase, 50 or 60 Hz 9.75 x 6.5 x 5.25H	115 or 230 VAC 1 phase, 400 Hz 9.75 x 6.5 x 5.25H	115 or 230 VAC 1 phase, 50 or 60 Hz 13.25 x 9 x 6.875H
Weight	40.75 lb	(0.182 ft ³ /kVA) 19 lb	(1.54 ft ³ /kVA) 14 lb	(1.54 ft ³ /kVA) 37 lb
Voltage Reg	(13.6 lb/kVA)	(152 lb/kVA)	(112 lb/kVA)	(148 lb/kVA)
Frequency Regulation		0.15%	0.15%	0.15%
Harmonic Distortion	5%	5%	5%	5%
Environment				
	-55 to 71°C 55000 ft	-20 to 50°C	-20 to 50°C	-20 to 50°C

X denotes input voltage

INVERTER
 $0 < P \leq 5 \text{ kW}$

Table 2. (Continued).

Company	Nova Electric	Nova Electric	Nova Electric
Model			
	25400XX	5060XX	1K6012
Rating	0.25 kVA	0.5 kVA	0.5 kVA
Input			1 kVA
Output	12 or 24 VDC	12 or 24 or 48 or 120 VDC	12 or 24 VDC
Size	115 or 230 VAC 1 phase, 400 Hz 13.25 x 9 x 6.875H	115 or 230 VAC 1 phase, 50 or 60 Hz 14.25 x 11.25 x 6.875H	115 or 230 VAC 1 phase, 400 Hz 14.5 x 11.25 x 6.875H
Weight	(1.90 ft ³ /kVA) 25 lb	(1.28 ft ³ /kVA) 60 lb	(1.30 ft ³ /kVA) 45 lb
Voltage Reg	(100 lb/kVA)	(120 lb/kVA)	(90 lb/kVA)
Frequency Regulation	0.15%	0.15%	0.15%
Harmonic Distortion	5%	5%	5%
Environment			
	-20 to 50°C	-20 to 50°C	-20 to 50°C
			-20 to 50°C

x denotes input voltage

INVERTER
 $0 < P \leq 5 \text{ kW}$

Table 2. (Continued).

Company	Nova Electric	Nova Electric	Nova Electric	Nova Electric
Model				
1K60XX	1K400XX	2K60XX	2K400XX	
Rating	1 kVA	1 kVA	2 kVA	2 kVA
Input				
	24 or 48 or 120 VDC	12 or 24 VDC	24 or 48 or 120 VDC	24 VDC
Output				
	115 or 230 VAC 1 phase, 50 or 60 Hz	115 or 230 VAC 1 phase, 400 Hz	115 or 230 VAC 1 phase, 50 or 60 Hz	115 or 230 VAC 1 phase, 400 Hz
Size	16 x 13.75 x 8.75H	14.5 x 11.25 x 6.875H	19 x 19 x 14H	19 x 19 x 14H
	(1.11 ft ³ /kVA)	(0.649 ft ³ /kVA)	(1.46 ft ³ /kVA)	(1.46 ft ³ /kVA)
Weight	100 lb (100 lb/kVA)	70 lb (70 lb/kVA)	200 lb (100 lb/kVA)	140 lb (70 lb/kVA)
Voltage Req	18	18	18	18
Frequency Regulation	0.15%	0.15%	0.15%	0.15%
Harmonic Distortion	5%	5%	5%	5%
Environment				
	-20 to 50°C	-20 to 50°C	-20 to 50°C	-20 to 50°C

X denotes input voltage

INVERTER
 $0 < P \leq 5 \text{ kW}$

Table 2. (Continued).

Company	Nova Electric	Nova Electric	Nova Electric	Nova Electric
Model	3K60XX	3K400XX	5K60XX	5K400XX
Rating ²	3 kVA	3 kVA	5 kVA	5 kVA
Input	24 or 48 or 120 VDC	24 VDC	48 or 120 VDC	120 VDC
Output	115 or 230 VAC 1 phase, 50 or 60 Hz	115 or 230 VAC 1 phase, 400 Hz 19 x 19 x 14 in (0.975 ft ³ /kVA)	115 or 230 VAC 1 phase, 50 or 60 Hz 24 x 17 x 21 in (0.992 ft ³ /kVA)	115 or 230 VAC 1 phase, 400 Hz 24 x 17 x 21 in (0.992 ft ³ /kVA)
Weight	250 lb	160 lb	265 lb	205 lb
Voltage Reg	(83.3 lb/kVA)	(53.3 lb/kVA)	(53.0 lb/kVA)	(41.0 lb/kVA)
frequency Regulation	0.15%	0.15%	0.15%	0.15%
Harmonic Distortion	5%	5%	5%	5%
Environment	-20 to 50°C	-20 to 50°C	-20 to 50°C	-20 to 50°C

X denotes input voltage

INVERTER
 $0 < P < 5\text{ kW}$

Table 2. (Continued).

Company	California Instruments	California Instruments	California Instruments	California Instruments
Model	101T	161T	251T	251TC
Rating	0.1kVA	0.16kVA	0.25kVA	0.25kVA
Input	115 or 208 or 220 or 230 or 240 VAC, 1 phase 48 to 65 Hz	115 or 208 or 220 or 230 or 240 VAC, 1 phase 48 to 65 Hz	115 or 208 or 220 or 230 or 240 VAC, 1 phase 48 to 65 Hz	115 or 208 or 220 or 230 or 240 VAC, 1 phase 48 to 65 Hz
Output				
Size	21 x 19 x 3 1/2H (8.08 ft ³ /kVA)	21 x 19 x 3 1/2H (5.05 ft ³ /kVA)	0 to 120 VAC 45 to 5000 Hz (4.85 ft ³ /kVA)	0 to 30, 0 to 75 0 to 135 VAC 45 to 20000 Hz (4.85 ft ³ /kVA)
Weight	35 lb (350 lb/kVA)	35 lb (219 lb/kVA)	60 lb (240 lb/kVA)	70 lb (280 lb/kVA)
Voltage Req				
Frequency Regulation				
harmonic Distortion	0.98	0.98	0.98	0.98
Environment			0 to 55°C	0 to 55°C
			0 to 55°C	0 to 55°C

INVERTER
 $0 < P \leq 5\text{kW}$

Table 2. (Continued).

Company	Topaz Powermark Div.	Topaz Powermark Div.	Topaz Powermark Div.	Topaz Powermark Div.
Model	2597-23	2598	2569-23	2682
Rating	\$5380 (\$2.15/VA)	\$5670 (\$2.27/VA)	\$8485 (\$1.70/VA)	\$8540 (\$1.73/VA)
Input	2.5kVA	2.5kVA	5.0kVA	5.0kVA
Output	48 or 125VDC	48 or 125VDC	48 or 125VDC	48 or 125VDC
Size	115VAC, 60Hz 21 x 19 x 14H (1.29 ft ³ /kVA)	230VAC, 50Hz 21 x 19 x 14H (1.29 ft ³ /kVA)	115VAC, 60Hz 21 x 19 x 21H (0.97 ft ³ /kVA)	230VAC, 60Hz 21 x 19 x 21H (0.97 ft ³ /kVA)
Weight	185 lb	185 lb	265 lb	265 lb
Voltage Reg	(74 lb/kVA)	(74 lb/kVA)	(53 lb/kVA)	(53 lb/kVA)
Frequency Regulation	2%	2%	2%	2%
Harmonic Distortion	5%	5%	5%	5%
Environment	0 to 55°C 0 to 90%RH			

Table 2. (Continued).

Company	Topaz Powermark Div.	Topaz Powermark Div.	Topaz Powermark Div.	Topaz Powermark Div.
Model 55X1	53XX	55X2	55X3	55X3
\$5545, #5511 (\$3.47/VA)	\$2770, #5323 (\$2.77/VA)	\$5375, #5512 (\$2.69/VA)	\$5535, #5513 (\$2.77/VA)	
Rating				
Input	1.6 kVA	1.0 kVA	2.0 kVA	2.0 kVA
Output	12 or 24 or 28 VDC or 125 VDC	12 or 24 or 28 or 48 or 125 VDC	12 or 24 or 28 VDC	12 or 24 or 28 VDC
Size	115 or 230 VAC, 50 Hz 13 x 19 x 14H	115 or 230 VAC, 60 Hz 13 x 19 x 7H	115 VAC, 60 Hz 13 x 19 x 14H	115 or 230 VAC, 50 Hz 13 x 19 x 14H
Weight	(1.25 ft ³ /kVA) 190 lb	(1.0 ft ³ /kVA) 95 lb	(1.0 ft ³ /kVA) 190 lb	(1.0 ft ³ /kVA) 190 lb
Voltage Reg	(119 lb/kVA) 2%	(95 lb/kVA) 2%	(95 lb/kVA) 2%	(95 lb/kVA) 2%
Frequency Regulation	0.5%	0.5%	0.5%	0.5%
Harmonic Distortion	5%	5%	5%	5%
Environment	-10 to 55°C 0 to 90%	-10 to 55°C 0 to 90%	-10 to 55°C 0 to 90%	-10 to 55°C 0 to 90%

X denotes input voltage

INVERTER
 $0 < P \leq 5 \text{ kW}$

Table 2. (Continued).

Company	Bendix Corp	EMP Electronics	Leland
Model			
39BL69-4	PS304C	ASH634-2	
Rating			
1 kVA	0.25 kVA	0.125 kVA	
Input			
28 VDC	28 VDC	24 to 32 VDC	
Output			
	115 VAC, 1 phase, 400 Hz (0.252 ft ³ /kVA)	115 VAC, 400 Hz (0.636 ft ³ /kVA)	26 or 115 VAC 1 phase, 400 Hz (0.513 ft ³ /kVA)
Size	11.3 x 5.5 x 7H 20 lb	9 1/4 x 4 3/4 x 6 1/4H 9 lb	8.15 x 5 x 2.7H 4.3 lb
Weight	(20 lb/kVA)	(36 lb/kVA)	(34.4 lb/kVA)
Voltage Reg			
Frequency Regulation			5%
Harmonic Distortion			
Environment			-55 to 71°C 55000 ft
	-55 to 85°C 65000 ft	-55 to 71°C	-55 to 71°C 55000 ft

INVERTERS
5 < P \leq 15kW

Table 2. (Continued).

Company	Varo	Varo	Powertronic Systems Inc.	Elgar Corp
Model	4345	4406		INV-103
Rating	6.5kW	10kW	14kVA	10kVA
Input				
Output	210-335VDC	180-355VDC	180VDC	105-140VDC
Size	115v, 3 phase, 400Hz	120v, 3 phase, 400Hz	120VAC, 3 phase, 0-700Hz	120VAC 19 x 44 x 78H (3.77 ft ³ /kVA)
Weight				1400 lb (140 lb/kVA)
Voltage Reg			1%	2%
Frequency Regulation			0.01%	0.25%
Harmonic Distortion			2% (output)	5%
Environment			65°C 100%RH	0 to 40°C

Table 2. (Continued).

Company	Leland	Nova Electric	Nova Electric	Nova Electric
Model				
	ASH724-1	7.5K60XX	7.5K-3/6-XX	10K60XX
Rating	5.6 kW	7.5 kVA	7.5 kVA	10 kVA
Input				
	33 VDC	120 or 240 VDC	24 or 48 or 120 or 240 VDC	120 or 240 VDC
Output				
	120 or 208 VAC 3 phase, 400 Hz	115 or 230 VAC 1 phase, 50 or 60 Hz 24 x 17 x 42H	115 or 230 VAC, 3 phase 50 or 60 or 400 Hz 24 x 17 x 63H	115 or 230 VAC, 3 phase 1 phase, 50 or 60 Hz 30 x 22 x 32H
Size	19.6 x 15.4 x 10.5H			
Weight	98 lb	(0.328 ft ³ /kVA) 405 lb	(1.32 ft ³ /kVA) 615 lb	(1.98 ft ³ /kVA) 550 lb
Voltage Reg	5%	(17.5 lb/kVA) 18	(54 lb/kVA) 18	(82 lb/kVA) 18
Frequency Regulation		0.15%	0.15%	0.15%
Harmonic Distortion		5%	5%	5%
Environment				
	-46 to 65°C 10000 ft	-20 to 50°C	-20 to 50°C	-20 to 50°C

X denotes input voltage

Table 2. (Continued).

Company	Topaz Powermark Div.	Topaz Powermark Div.	Nova Electric	Nova Electric
Model	2101	2683		
	\$15480 (\$1.55/V _A)	\$15570 (\$1.56/V _A)	10K-3/6-XX	15K-3/6-XX
Rating				
Input	10.0kVA	10.0kVA	10kVA	15 kVA
Output	125 or 250VDC	125 or 250VDC	48 or 120 or 240 VDC	48 or 120 or 240 VDC
Size	115VAC, 60Hz 31 x 23 1/4 x 62H (2.59 ft ³ /kVA)	230VAC, 60Hz 31 x 23 1/4 x 62H (2.59 ft ³ /kVA)	115 or 230 VAC, 3 phase 50 or 60 or 400 Hz 24 x 17 x 42H (0.992 ft ³ /kVA)	115 or 230 VAC, 3 phase 50 or 60 or 400 Hz 24 x 17 x 63H (0.992 ft ³ /kVA)
Weight	700 lb	700 lb	530 lb	800 lb
Voltage Reg	(70 lb/kVA)	(70 lb/kVA)	(53 lb/kVA)	(53.3 lb/kVA)
Frequency Regulation	0.5%	0.5%	0.15%	0.15%
Harmonic Distortion	5%	5%	5%	5%
Environment				
	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH	-20 to 50°C	-20 to 50°C

X denotes input voltage

INVERTER
 $5 < P \leq 15 \text{ kW}$

Table 2. (Continued).

Company	Nova Electric
Model	10K400XX
Rating	10 kVA
Input	120 VDC
Output	115 or 230 VAC 1 phase, 400 Hz
Size	30 x 22 x 32H (1.22 ft ³ /kVA)
Weight	405 lb (40.5 lb/kVA)
Voltage Reg	1%
Frequency Regulation	0.15%
Harmonic Distortion	5%
Environment	-20 to 50°C

x denotes input voltage

INVERTER
 $15 \leq P \leq 60 \text{ kW}$

Table 2. (Continued).

Company	Nova Electric	Nova Electric	Elgar Corp
Model	20K-3/6-XX	30K-3/6-XX	INV-203
Rating	20 kVA	30 kVA	20 kVA
Input			
	120 or 240 VDC	120 or 240 VDC	105 to 140 VDC
Output			
	115 or 230 VAC, 3 phase 50 or 60 or 400 Hz	115 or 230 VAC, 3 phase 50 or 60 or 400 Hz	120 VAC
Size	30 x 44 x 32H	30 x 66 x 32H	24 x 54 x 80H
	(1.22 ft ³ /kVA)	(1.22 ft ³ /kVA)	(3.0 ft ³ /kVA)
Weight	1100 lb	1650 lb	2000 lb
	(55 lb/kVA)	(55 lb/kVA)	(100 lb/kVA)
Voltage Reg	1%	1%	2%
Frequency Regulation	0.15%	0.15%	0.25%
Harmonic Distortion	5%	5%	5%
Environment			
		-20 to 50°C	0 to 40°C

X denotes input voltage

INVERTER
 $15 < P \leq 60 \text{ kVA}$

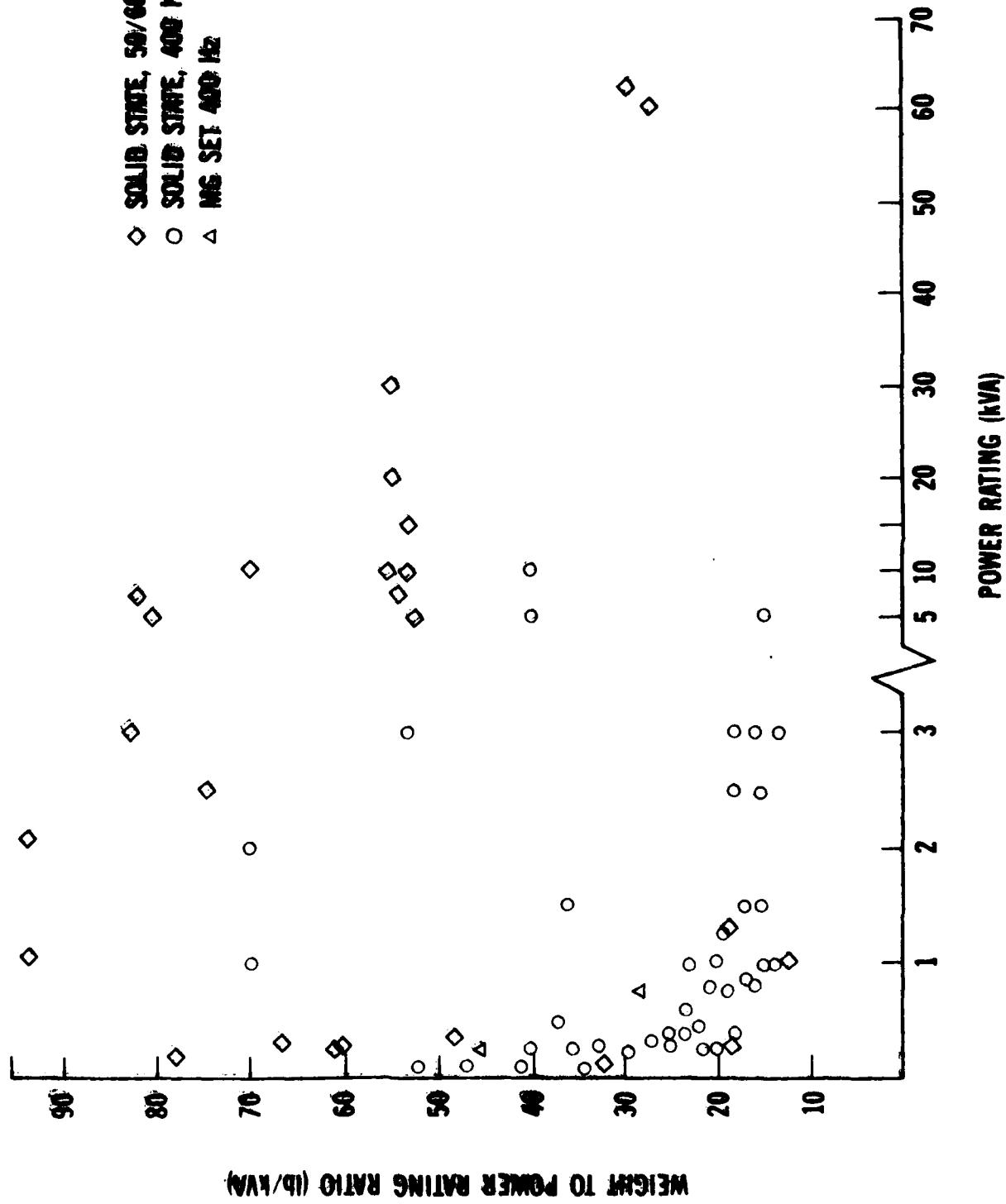
Table 2. (Continued).

Company	CTS of Canada	CTS of Canada
Model	8000	8300
Rating	40kVA	125kVA
Input		
Output	up to 275VDC	up to 275VDC
Size	various, 1 phase, 50 or 60 or 400Hz	various, 1 phase, 50 or 60 or 400Hz
Weight		
Voltage Reg	2%	2%
Frequency Regulation	0.01%	0.01%
harmonic Distortion	3 to 5%	3 to 5%
Environment	32 to 132°F 95%RH 10,000 ft	32 to 132°F 95%RH 10,000 ft

INVERTERS
 $60\text{kW} < P \leq$

Table 2. (Continued).

Company	Westinghouse	DECC	DECC
Model	AVI-623	61264	61240
Rating	62.5kW or kVA	75kW	300kW
Input	200-300VDC	180-290VDC	300-450VDC
Output			
	120 or 277 VAC 3 phase 4 wire 60Hz	480v 3 phase, 60Hz	480v 3 phase, 60Hz
Size	33 x 33 x 82H (0.83 ft ³ /kVA)	36 x 84 x 76H (1.77 ft ³ /kVA)	1m x 3.5m x 2mH (0.824 ft ³ /kVA)
Weight	1830 lb (29 lb/kVA)		
Voltage Reg	$\pm 5\%$		
Frequency Regulation	1 3.33%		
Harmonic Distortion	THD = 5% max	3% current (output)	3% current (output)
Environment		-10 to 45°C 0-96%RH noncondensing 790-520mm Hg	



3. Converters, a.c. to d.c. (Table 3). The a.c. to d.c. converters are used to generate a regulated d.c. output from an a.c. source. Battery chargers, d.c. power supplies, and transformer rectifier units are examples of this function. Although the Goodall units conform to military specifications, they do not appear as outstanding candidates for Army tactical applications because of weight to power ratio (60 lb/kVA to 200 lb/kVA) and narrow operating temperature range (23° C to 50° C). The Aerospace Avionics unit has a narrow temperature range (0° C to 50° C). The Bendix units have power to weight ratios of about 3 lb/kVA; these are 400-Hz units.

CONVERTERS AC TO DC
0 < P ≤ 5kW

Table 3.

Company	Aerospace Avionics	Good-All Electric	Good-All Electric	Good-All Electric
Model		MIL-P 15736/4	MIL-P 15736/7	MIL-C-24095
Rating	150A converter			
Input	150A @ 24v, 3.6kW	1.6kW	1.6kW	2kW
Output	117/208 VAC, 60 or 400Hz	440 VAC, 3 phase, 60Hz	208/440, 3 phase, 60Hz	115v, 1 phase, 60Hz
	24-30 VDC	26-40 VDC	26-40 VDC	2.5, 7.5, 10, 15, 30, 45 VDC
Size	18 x 22 x 30H	10 x 16 x 24H	(4.3 ft ³ /kVA)	12 x 18 x 19H (1.2 ft ³ /kVA)
Weight	320 lb	175 lb	(200 lb/kVA)	125 lb (62 lb/kVA)
Voltage Reg	.5%	± 1%	± 1%	± 1%
Frequency Regulation				
Harmonic Distortion				
Environment		1% ripple	1% ripple	1% ripple
				23-50°C 100%RH 10,000ft elevation Outdoor enclosure
				23-50°C 100%RH 10,000ft elevation Outdoor enclosure
				23-50°C 100%RH 10,000ft elevation Outdoor enclosure

CONVERTERS AC TO DC
 $5 < P \leq 15\text{kW}$

Table 3. (Continued).

Company	Good-All Electric	Good-All Electric	Bendix Corp	Bendix Corp
Model	DOD-C-24529	MIL-P-15736/1	9B40-1	9B40-15
Rating	8.5 kW	10kW	5.2kVA	7.2kVA
Input				
Output	440v, 3 phase, 60Hz	440v, 3 phase, 60Hz	200VAC, 3 phase, 400Hz	200VAC, 3 phase, 400Hz
Size	19 x 26 x 38H (1.3 ft ³ /kVA)	24 x 24 x 48H (1.6 ft ³ /kVA)	28VDC (0.043 ft ³ /kVA)	28VDC (0.045 ft ³ /kVA)
Weight	650 lb (76 lb/kVA)	850 lb (85 lb/kVA)	17 lb (3.27 lb/kVA)	21 lb (2.92 lb/kVA)
Voltage Reg	$\pm 1\%$	$\pm 1\%$		
Frequency Regulation				
Harmonic Distortion	1% ripple	1% ripple		
Environment	23-50°C 100%RH 10,000ft elevation Outdoor enclosure	23-50°C 100%RH 10,000ft elevation Outdoor enclosure	10,000ft elevation Outdoor enclosure	60,000 ft

CONVERTERS DC to DC
0 < P \leq 5kW

Table 3. (Continued).

Company	Flite-Tronics PC - 6B	Flite-Tronics PC - 12A	RGS Electronics	RGS Electronics
Model	\$535 (\$1.95/VA)	\$535 (\$2.03/VA)	BC 14	BC 28
Rating	.275kVA	.263kVA	.07kVA	.07kVA
Input	13.5VDC	28.0VDC	20 - 36VDC	20 - 36VDC
Output				
Size	8 1/4 x 4 9/16 x 2 3/4H (0.218 ft ³ /kVA)	8 1/4 x 4 9/16 x 2 3/4H (0.228 ft ³ /kVA)	5.8 x 2.3 x 2.3H (0.254 ft ³ /kVA)	5.8 x 2.3 x 2.3H (0.254 ft ³ /kVA)
Weight	3.4 lb (12.4 lb/kVA)	4 lb 2 oz (15.7 lb/kVA)	1.5 lb (21.4 lb/kVA)	1.5 lb (21.4 lb/kVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion				
Environment				
			-55 to 71°C 50,000 ft	-55 to 71°C 50,000 ft
			170°F	

CONVERTERS DC to DC
 $0 < P < 5\text{kw}$

Table 3. (Continued).

Company	KGS Electronics	KGS Electronics	KGS Electronics	KGS Electronics
Model				
Model	EAL 2808	IS 120	LT 51	LT 52A
Rating	.07kVA	.112kVA	.075kVA	.05kVA
Input				
	20 - 36VDC	20 - 36VDC	20 - 40VDC	20 - 40VDC
Output				
	28VDC	28VDC	5VDC	0 - 5VDC adjustable
Size	8.25 x 4.5 x 3.55H (1.09 ft ³ /kVA)	5.75 x 2.25 x 2.25H (0.15 ft ³ /kVA)	6.8 x 2.4 x 2.3H (0.29 ft ³ /kVA)	5.8 x 2.3 x 2.3H (0.355 ft ³ /kVA)
Weight	2.5 lb	1.5 lb	1.5 lb	1.5 lb
Voltage Reg				
Frequency Regulation				
Harmonic Distortion				
Environment				
	-55 to 70°C 45,000 ft	-55 to 71°C	-55 to 71°C	-55 to 71°C

CONVERTERS DC to DC
 $0 < P \leq 5\text{kW}$

Table 3. (Continued).

Company	KGS Electronics	KGS Electronics	KGS Electronics	KGS Electronics
Model	LT 55	LT 70	LT 71	LT 100
Rating	.075kVA	.07kVA	.112kVA	.10kVA
Input	20 - 36VDC	20 - 40VDC	20 - 40 VDC	20 - 40VDC
Output				
	0 - 5VDC adjustable	0 - 12VDC adjustable	14VDC	0 - 28VDC adjustable
Size	5.2 x 3.4 x 2.7H	5.8 x 2.3 x 2.3H	6.8 x 2.4 x 2.3H	5.8 x 2.3 x 2.3H
	(0.368 ft ³ /kVA)	(0.254 ft ³ /kVA)	(0.194 ft ³ /kVA)	(0.178 ft ³ /kVA)
Weight	1.5 lb	1.5 lb	1.5 lb	1.5 lb
	(20 lb/kVA)	(21.4 lb/kVA)	(13.4 lb/kVA)	(15 lb/kVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion				
Environment	-55 to 70°C 50,000 ft	-55 to 70°C	-55 to 71°C	-55 to 71°C

CONVERTERS DC to DC
0 < P \leq 5kW

Table 3. (Continued).

Company	KGS Electronics	KGS Electronics	KGS Electronics	KGS Electronics
Model	LT 101	PB 50	RB 125	RB 126
Rating	.100kVA	.05kVA	.14kVA	.168kVA
Input	20 - 40VDC	11 - 30VDC	11 - 16VDC	13.5 - 16VDC
Output	28VDC	28VDC	28VDC	28VDC
Size	6.8 x 2.4 x 2.3H (0.217 ft ³ /kVA)	4 1/2 x 2 1/2 x 2 7/8H (0.374 ft ³ /kVA)	5.8 x 2.3 x 2.3H (0.127 ft ³ /kVA)	5.8 x 2.3 x 2.3H (0.106 ft ³ /kVA)
Weight	1.5 lb (15 lb/kVA)	1.5 lb (30 lb/kVA)	1.5 lb (10.7 lb/kVA)	1.5 lb (8.93 lb/kVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion				
Environment				
	-55 to 71°C	-65 to 165°F	-55 to 71°C	-55 to 71°C

CONVERTERS DC to DC
 $0 < P \leq 5\text{kW}$

Table 3. (Continued).

Company	KGS Electronics	KGS Electronics
Model	DC 14 - 28	DC 28 - 14
Rating	.275kVA	.24kVA
Input		
Output	13.5VDC	28VDC
	27.5VDC	13.2VDC
Size	8.25 x 4.56 x 2.75H (0.218 ft ³ /kVA)	8.25 x 4.56 x 2.75H (0.249 ft ³ /kVA)
Weight	3.4 lb (12.4 lb/kVA)	4 lb 2 oz (17.2 lb/kVA)
Voltage Reg		
Frequency Regulation		
Harmonic Distortion		
Environment		
	-55 to 70°C 45,000 ft	-55 to 70°C 45,000 ft

4. Uninterruptible Power Supplies (UPS) (Table 4). UPS are used to provide an unbroken supply of power for critical equipment or functions during temporary interruption of the primary power source. A complete UPS system includes a standby source of power to provide this no-break capability. The duration of the interruption during which the UPS system can provide power is determined by the energy capacity of the standby source (in relation to the load/power requirements). An UPS capability is of major importance to some military systems as represented by the power line conditioner in the communication system control element being developed by PM TRITAC.

A typical UPS system may consist of a rectifier/battery charger section operating from the primary a.c. supply, a battery bank which serves as the standby energy source, and an inverter section to provide a.c. power of suitable quality to the load, operating either from the rectified input or the battery bank. Such systems typically find use in critical computer systems or for solar power backup.

In the power range of less than 5 kW, none of the units reported has characteristics which are especially useful for military field applications. The operating temperature ranges are narrow (e.g., -10°C to $+40^{\circ}\text{C}$ is the widest range.). The weight to power ratios are in the 10^2 lb/kVA range. Voltage regulation is not within MIL-STD-1332 requirements for precise power, although frequency regulation is within that specification. Most models have voltage regulation within the 4-percent utility power definition. All the units are single frequency in and out.

In the 5-kW to 15-kW range, the same comments apply with the exception that Gould systems such as 6156-X and Exide systems such as 2710 have voltage regulation of 1 percent, which complies with MIL-STD-132 for precise power.

UNINTERRUPTIBLE POWER SUPPLIES
 $0 < P \leq 5\text{kW}$

Table 4.

Company	Cyberex	Cyberex	Cyberex
Model	110CV1-STS-50	120CV1-STS	110-CV2-STS-50
Rating	1kVA	1kVA	2kVA
Input	220v, 1 phase, 50Hz	120v, 1 phase, 60Hz	220v, 1 phase, 50Hz
Output	220/240/254v 1 phase, 50Hz	120v, 1 phase, 60Hz 23 5/8 x 33 1/3 x 52 1/2H (23 ft ³ /kVA)	220/240/254v 1 phase, 50Hz 600mm x 819mm x 1334mmH 600mm x 819mm x 1334mmH (23 ft ³ /kVA)
Size	600mm x 819mm x 1334mmH (23 ft ³ /kVA)	445 lb 202 kg (444 lb/kVA)	407 kg (445 lb/kVA)
Weight	445 lb 202 kg (444 lb/kVA)	+2%, -3% +3%, -4%	(448 lb/kVA) +3%, -4%
Voltage Reg	1/2%	+2%, -3%	+2%, -3%
Frequency Regulation	1/2%	1/2%	1/2%
Harmonic Distortion	5% (output)	5% (output)	5% (output)
Environment	-10°C to 40°C 0-95%RH	-10°C to 40°C 0-95%RH	-10°C to 40°C 0-95%RH
			-10°C to 40°C 0-95%RH

UNINTERRUPTIBLE POWER SUPPLIES
 $0 < P \leq 5\text{kW}$

Table 4. (Continued).

Company	Cyberex	Cyberex	Cyberex	Cyberex
Model	110CV3-STS-50	120CV3-STS	110CV5-STS-50	120CV5-STS
Rating				
Input	3kVA	3kVA	5kVA	5kVA
Output	220v, 1 phase, 50Hz	120v, 1 phase, 60Hz	220v, 1 phase, 50Hz	220v, 1 phase, 60Hz
Size	220/240/254v 1 phase, 50Hz 600mm x 819mm x 1873mmH (11 ft ³ /kVA)	120v, 1 phase, 60Hz 23 5/8 x 32 1/4 x 73 3/4H (11 ft ³ /kVA)	220/240/254v 1 phase, 50Hz 600mm x 819mm x 1873mmH (6.6 ft ³ /kVA)	120v, 1 phase, 60Hz 23 5/8 x 32 1/4 x 73 3/4H (6.6 ft ³ /kVA)
Weight	585 kg	1290 lb	651 kg	1436 lb
Voltage Reg	(429 lb/kVA)	(430 lb/kVA)	(286 lb/kVA)	(287 lb/kVA)
Frequency Regulation	+3%, -4%	+2%, -3%	+3%, -4%	+2%, -3%
Harmonic Distortion	5% (output)	1/2%	1/2%	1/2%
Environment	-10°C to 40°C 0-95%RH	-10°C to 40°C 0-95%RH	5% (output)	5% (output)
			-10°C to 40°C 0-95%RH	-10°C to 40°C 0-95%RH

UNINTERRUPTIBLE POWER SUPPLIES
 $0 < P \leq 5\text{kW}$

Table 4. (Continued).

Company	Elgar	Gould	Gould	Gould
Model	UPS 102-1B	DSU 20 series	DSU 20 series	DSU 20 series
Rating				
Input	1kVA	0.500kVA	0.750kVA	1kVA
Output	120v, 1 phase, 57-63Hz	120v, 57-63Hz	120v, 57-63Hz	120v, 57-63Hz
Size	20 x 19 x 8 3/4H (1.92 ft ³ /kVA)			
Weight	100 lb (100 lb/kVA)			
Voltage Reg	2%	3%	3%	3%
Frequency Regulation	0.05%	0.5%	0.5%	0.5%
Harmonic Distortion	5% (output)	5% (output)	5% (output)	5% (output)
Environment	-10°C to 40°C 0-95%RH noncondensing	0°C to 40°C	0°C to 40°C	0°C to 40°C

UNINTERRUPTIBLE POWER SUPPLIES
 $1 < P \leq 5 \text{ kW}$

Table 4. (Continued).

Company	Gould	Gould	Gould	Gould
Model	DSU 20 series	DSU 20 series	DSU 20 series	524X
Rating				
Input	1.2kVA	1.5kVA	1.8kVA	3kVA
Output	120v, 57-63Hz	120v, 57-63Hz	120v, 57-63Hz	120 or 240v, 60Hz (48 or 125 DC)
Size	120v, 60Hz	120v, 60Hz	60Hz	120v, 1 phase, 60Hz 32 x 4 x 61H (1.5 ft ³ /kVA)
Weight				1050 lb (350 lb/kVA)
Voltage Reg	3%	3%	3%	
Frequency Regulation	0.5%	0.5%	0.5%	+0.5%
Harmonic Distortion	5% (output)	5% (output)	5% (output)	5% (output)
Environment				0°C to 40°C
				0°C to 40°C

X = number specifying input voltage, phase and power

UNINTERRUPTIBLE POWER SUPPLIES
 $0 < P \leq 5\text{kW}$

Table 4. (Continued).

Company	Gould	Elgar Corp	Elgar Corp	Elgar Corp
Model	524X	UPS-501-1-113	UPS-252-1	UPS-2525-1
Rating	5kVA	0.5kVA	2.5kVA	2.5kVA
Input	120 or 240 or 480 or 208v (125v DC)	115VAC, 1 phase, 60Hz	115VAC, 1 phase, 60Hz	230VAC, 1 phase, 50Hz
Output				
Size	32 x 4 x 61H	19 x 19 x 7H (2.92 ft ³ /kVA)	19 x 19 x 14H (1.17 ft ³ /kVA)	19 x 19 x 19.25H (1.61 ft ³ /kVA)
Weight	1300 lb (260 lb/kVA)	93 lb (186 lb/kVA)	213 lb (85.2 lb/kVA)	318 lb (127.2 lb/kVA)
Voltage Reg		2%	2%	2%
Frequency Regulation	$\pm 0.5\%$	0.25%	0.25%	0.25%
Harmonic Distortion	5% (output)	5%	5%	5%
Environment		0 to 40°C 95%RH	0 to 40°C 95%RH	0 to 40°C 95%RH

X = number specifying input voltage, phase and power

UNINTERRUPTIBLE POWER SUPPLIES
 $0 < P \leq 5\text{kW}$

Table 4. (Continued).

Company	Mawdsleys Limited	Mawdsleys Limited	Mawdsleys Limited	Elgar Corp
Model				UPS-102-1-136
Rating	1kVA	2kVA	5kVA	1kVA
Input	250 or 110VAC, single phase, 50 or 60Hz	250 or 110VAC, single phase, 50 or 60Hz	250 or 110VAC, single phase, 50 or 60Hz	115VAC, 1 phase, 60Hz
Output				
Size	24 x 28 x 64H (24.9 ft ³ /kVA)	25.2 x 36 x 72H (18.9 ft ³ /kVA)	25.2 x 48 x 72H (10.1 ft ³ /kVA)	19 x 19 x 12.25H (2.56 ft ³ /kVA)
Weight	572 lb (572 lb/kVA)	946 lb (473 lb/kVA)	1606 lb (321 lb/kVA)	198 lb (198 lb/kVA)
Voltage Reg	5%	5%	5%	2%
Frequency Regulation	0.5%	0.5%	0.5%	0.25%
Harmonic Distortion	3%	3%	3%	5%
Environment	40°C 95%RH 3,281 ft outdoor enclosure	40°C 95%RH 3,281 ft outdoor enclosure	40°C 95%RH 3,281 ft outdoor enclosure	0 to 40°C 95%RH

UNINTERRUPTIBLE POWER SUPPLIES
 $0 < P \leq 5\text{ kVA}$

Table 4. (Continued).

Company	Elgar Corp
Model	UPS-502-1A
Rating	5kVA
Input	115 or 230VAC 1 phase, 60Hz
Output	
	115 or 230VAC 1 phase, 60Hz
Size	17.5 x 43 x 60.5H (5.27 ft ³ /kVA)
Weight	1050 lb (210 lb/kVA)
Voltage Reg	2%
Frequency Regulation	0.25%
Harmonic Distortion	5%
Environment	0 to 50°C 95%RH

UNINTERRUPTIBLE POWER SUPPLIES
 $5 < P \leq 15\text{kW}$

Table 4. (Continued).

Company	Bogue	Cyberex	Cyberex	Gould
Model	7537	110CV7.5-STS-50	120CV7.5-STS	5250
Rating	7.5kW	7.5kVA	7.5kVA	7.5kVA
Input	120v, 3 phase, 60Hz	220v, 1 phase, 50Hz	120v, 1 phase, 60Hz	208 or 480v, 3 phase (125v DC)
Output				
Size	120v, 1 phase, 60Hz	220/240/254v 1 phase, 50Hz	120v, 1 phase, 60Hz	120v, 1 phase
	600mm x 819mm x 1873mm	5/8 x 32 1/4 x 73 3/4H	32 x 29 x 61H	
	(4.3 ft ³ /kVA)	(4.4 ft ³ /kVA)	(4.4 ft ³ /kVA)	
Weight	900 kg	1800 lb	1500 lb	
Voltage Reg	28	(264 lb/kVA) +38, -48	(240 lb/kVA) +28, -38	(200 lb/kVA)
Frequency Regulation	3%	1/2%	1/2%	+0.5%
Harmonic Distortion		5% (output)	5% (output)	5% (output)
Environment		-10 to 40°C 0-95%RH	-10 to 40°C 0-95%RH	

UNINTERRUPTIBLE POWER SUPPLIES
 $5 < P \leq 15\text{kW}$

Table 4. (Continued).

Company	Gould	Gould	Gould	Exide Electronics
Model	5254	5255	6156-X	2015
Rating	10kVA	15kVA	15kVA	15kW, 18.75kVA
Input	208 or 480v, 3 phase (125v DC)	208 or 480v, 3 phase (125v DC)	208 or 480v, 60Hz	208 or 480 or 600 or 210 or 400VAC 3 phase, 50 or 60Hz
Output				120/208 or 277/480 or 346/600 or 120/210 or 230/400VAC 3 phase, 50 or 60Hz
Size	32 x 56 x 61H	32 x 56 x 61H	120v, 1 phase	30 x 52 x 72H
	(6.3 ft ³ /kVA)	(4.2 ft ³ /kVA)	120/208v, 60Hz	(3.47 ft ³ /kVA)
Weight	2350 lb	2750 lb		850 lb
	(235 lb/kVA)	(183 lb/kVA)		(45.3 lb/kVA)
Voltage Reg			1%	1%
Frequency Regulation	$\pm 0.5\%$	$\pm 0.5\%$	0.5%	0.1%
Harmonic Distortion	5% (output)	5% (output)	5% (output) 10% (input)	5%
Environment				0 to 50°C 95%RH

X = number specifying input voltage

UNINTERRUPTIBLE POWER SUPPLIES
 $5 < P \leq 15\text{kW}$

Table 4. (Continued).

Company	Exide Electronics	Elgar Corp	Elgar Corp	Elgar Corp
Model		UPS-652-1A	UPS-103-1A	UPS-103-3A
Rating	15kW, 18.75kVA	6.5kVA	10kVA	10kVA
Input	208 or 480 or 600 or 210 or 400VAC 3 phase, 50 or 60Hz	115 or 230VAC 1 phase, 60Hz	115 or 230VAC 1 phase, 60Hz	115 or 230VAC 3 phase, 60Hz
Output				
Size	120 or 230 or 240VAC 1 phase, 50 or 60Hz 30 x 52 x 72H	115 or 230VAC 1 phase, 60Hz 17.5 x 43 x 64.5H	115 or 230VAC 1 phase, 60Hz 19 x 55 x 72.5H	115 or 230VAC 3 phase, 60Hz 19 x 55 x 72.5H
Weight	(3.47 ft ³ /kVA) 850 lb	(4.32 ft ³ /kVA) 1250 lb	(4.38 ft ³ /kVA) 1800 lb	(4.38 ft ³ /kVA) 2000 lb
Voltage Reg	(45.3 1b/kVA)	(192.3 1b/kVA)	(180 1b/kVA)	(200 1b/kVA)
Frequency Regulation	1%	2%	2%	1%
Harmonic Distortion	0.1%	0.25%	0.25%	0.25%
Environment	5%	5%	5%	5%
	0 to 50°C 95%RH	0 to 50°C 95%RH	0 to 50°C 95%RH	0 to 50°C 95%RH

UNINTERRUPTIBLE POWER SUPPLIES
5 < P \leq 15kW

Table 4. (Continued).

Company	Mawdsleys Limited	Mawdsleys Limited	Mawdsleys Limited	Exide Electronics
Model				2710
Rating	7kVA	10kVA	15kVA	10kW, 12.5kVA
Input	350 or 208VAC, 3 phase, 50 or 60Hz	350 or 208VAC, 3 phase, 50 or 60Hz	350 or 208VAC, 3 phase, 50 or 50Hz	208 or 480 or 600 or 210 or 400VAC 3 phase, 50 or 60Hz
Output				120 or 230 or 240VAC 1 phase, 50 or 60Hz
Size	25.2 x 56 x 72H	25.2 x 64 x 72H	25.2 x 64 x 72H	30 x 52 x 72H
	(8.4 ft ³ /kVA)	(6.72 ft ³ /kVA)	(4.48 ft ³ /kVA)	(5.2 ft ³ /kVA)
Weight	2046 lb	2420 lb	2860 lb	750 lb
	(292 lb/kVA)	(242 lb/kVA)	(191 lb/kVA)	(60 lb/kVA)
Voltage Reg	5%	5%	5%	1%
Frequency Regulation	0.5%	0.5%	0.5%	0.1%
Harmonic Distortion	3%	3%	3%	5%
Environment	40°C 95%RH 3,281 ft outdoor enclosure	40°C 95%RH 3,281 ft outdoor enclosure	40°C 95%RH 3,281 ft outdoor enclosure	0 to 50°C 95%RH

UNINTERRUPTIBLE POWER SUPPLIES
 $5 < P \leq 15\text{kW}$

Table 4. (Continued)

Company	Elgar Corp	Elgar Corp
Model	UPS-153-1	UPS-153-3A
Rating	15kVA	15kVA
Input	120 or 208VAC 3 phase, 60Hz	120 or 208VAC 3 phase, 60Hz
Output		
Size	115 or 230VAC 1 phase, 60Hz 27 x 54 x 72H (4.05 ft ³ /kVA)	120 or 208VAC 3 phase, 60Hz 27 x 55 x 76.5H (4.38 ft ³ /kVA)
Weight	2300 lb	2250 lb
Voltage Reg	(153.3 lb/kVA)	(150 lb/kVA)
Frequency Regulation	2%	1%
Harmonic Distortion	5%	5%
Environment	0 to 50°C 95%RH	0 to 50°C 95%RH

UNINTERRUPTIBLE POWER SUPPLIES
 $15 < P \leq 60\text{kW}$

Table 4. (Continued).

Company	Elgar	Gould	Gould	Gould
Model	UPS 503-3B	5256	6306-X	6456-X
Rating	50kVA	20kVA	30kVA	45kVA
Input	120/208v, 3 phase (or 480v), 57 to 63Hz		208 or 480v, 60Hz	208 or 480v, 60Hz
Output	120/208v, 3 phase (or 480v), 60Hz		120/280v or 277/480v, 60Hz	120/208v or 277/480v, 60Hz
Size		32 x 68 x 70H (3.9 ft ³ /kVA)		
Weight		2950 lb (390 lb/kVA)		
Voltage Reg	2%	$\pm 3\%$	1%	1%
Frequency Regulation	.01Hz	$\pm 0.5\%$	0.1Hz	0.1Hz
Harmonic Distortion	5% (output)	5% (output)	5% (output), 10% (input)	5% (output), 10% (input)
Environment			0-40°C	0-40°C

X = number specifying input and output combination

UNINTERRUPTIBLE POWER SUPPLIES
 $15 < P \leq 60\text{kW}$

Table 4. (Continued).

Company	Teledyne Inet Series 75	Elgar Corp	Elgar Corp	Elgar Corp
Model	\$42775 (\$0.57/kVA)	UPS-183-3	UPS-203-1	UPS-253-3
Rating	60 kW 75kVA	17.5kVA	20kVA	25kVA
Input	208 or 480v cable, 60Hz	120 or 208VAC 3 phase, 60Hz	120 or 208VAC 3 phase, 60Hz	120 or 208VAC 3 phase, 60Hz
Output	208 or 480v cable, 60Hz	120 or 208VAC 3 phase, 60Hz	115 or 230VAC 1 phase, 60Hz	120 or 208VAC 3 phase, 60Hz
Size	60 x 36 x 80H (1.4 ft ³ /kVA)	26 x 55 x 76.5H (3.62 ft ³ /kVA)	24 x 60 x 80H (3.33 ft ³ /kVA)	26.5 x 102.5 x 80H (5.03 ft ³ /kVA)
Weight	4400 lb (59 lb/kVA)	2550 lb (145.7 lb/kVA)	2600 lb (130 lb/kVA)	4004 lb (160.2 lb/kVA)
Voltage Reg	$\pm 1\%$	1%	2%	1%
Frequency Regulation	$\pm .05\text{Hz}$	0.25%	0.25%	0.25%
Harmonic Distortion	5% (output) 10% (input)	5%	5%	5%
Environment	0-40°C 0-95%RH 0-5000' elevation NEMA I enclosure	0 to 50°C 95%RH	0 to 50°C 95%RH	0 to 50°C 95%RH

UNINTERRUPTIBLE POWER SUPPLIES
 $15 < P \leq 60\text{kW}$

Table 4. (Continued).

Company	Mawdsleys Limited	Mawdsleys Limited	Elgar Corp	Elgar Corp
Model			UPS-373-3	UPS-453-3
Rating				
Input	20kVA	25kVA	37.5kVA	45kVA
Output	350 or 208VAC, 3 phase, 50 or 60Hz	350 or 208VAC, 3 phase, 50 or 60Hz	120 or 208VAC 3 phase, 60Hz	120 or 208VAC 3 phase, 60Hz
Size	25.2 x 100 x 72H	25.2 x 100 x 72H	26.5 x 102.5 x 80H	26.5 x 102.5 x 80H
(5.25 ft ³ /kVA)	(4.2 ft ³ /kVA)	(3.35 ft ³ /kVA)	(2.79 ft ³ /kVA)	(2.79 ft ³ /kVA)
Weight	3740 lb	4180 lb	4700 lb	5100 lb
(187 lb/kVA)	(167 lb/kVA)	(125.3 lb/kVA)	(113.3 lb/kVA)	(113.3 lb/kVA)
Voltage Reg	5%	5%	1%	1%
Frequency Regulation	0.5%	0.5%	0.25%	0.25%
Harmonic Distortion	3%	3%	5%	5%
Environment	40°C 95%RH 3,281 ft outdoor enclosure	40°C 95%RH 3,281 ft outdoor enclosure	0 to 50°C 95%RH	0 to 50°C 95%RH

UNINTERRUPTIBLE POWER SUPPLIES
 $15 < P \leq 60\text{kW}$

Table 4. (Continued).

Company	Exide Electronics	Exide Electronics	Franklin Electric	Franklin Electric
Model				
3060	5060	550	650	
Rating				
60kW, 75kVA	60kW, 75kVA	50kVA	50kVA	
Input				
208 or 480 or 600VAC 3 phase, 60Hz	204 or 380 or 400 or 415VAC, 3 phase, 50Hz	380 or 400 or 415VAC 3 phase, 50Hz	120 or 208 or 277 or 480VAC, 3 phase, 60Hz	
Output				
120/208 or 277/480 or 346/600VAC 3 phase, 60Hz	118/204 or 220/380 or 230/400 or 240/415VAC 3 phase, 50Hz	380 or 400 or 415VAC 3 phase, 50Hz	120 or 208 or 277 or 480VAC, 3 phase, 60Hz	
Size	32 x 64 x 84H	40 x 64 x 82H	36 x 72 x 72H	36 x 72 x 72H
(1.33 ft ³ /kVA)	(1.62 ft ³ /kVA)	(2.16 ft ³ /kVA)	(2.16 ft ³ /kVA)	
Weight	4720 lb	5182 lb	4000 lb	4000 lb
(62.9 lb/kVA)	(69.1 lb/kVA)	(80 lb/kVA)	(80 lb/kVA)	
Voltage Reg	1%	1%	1%	1%
Frequency Regulation	$\pm 0.06\text{Hz}$	$\pm 0.05\text{Hz}$	0.5%	0.5%
Harmonic Distortion	5%	5%	5%	5%
Environment	0 to 40°C 95%RH	95°C 40°C 4000 ft	95%RH 3300 ft	32 to 104°F 95%RH 3300 ft

UNINTERRUPTIBLE POWER SUPPLIES
 $15 < P \leq 60\text{kW}$

Table 4. (Continued).

Company	Exide Electronics	Exide Electronics	Exide Electronics	Exide Electronics
Model	2720	2030	2730	2045
Rating	20kW, 25kVA	30kW, 37.5kVA	30kW, 37.5kVA	45kW, 56.25kVA
Input	208 or 480 or 600 or 210 or 400VAC 3 phase, 50 or 60Hz	208 or 480 or 600 or 210 or 400VAC 3 phase, 50 or 60Hz	208 or 480 or 600 or 210 or 400VAC 3 phase, 50 or 60Hz	208 or 480 or 600 or 210 or 400VAC 3 phase, 50 or 60Hz
Output				
Size	30 x 52 x 72H			
Weight	(2.6 ft ³ /kVA) 1100 lb	(1.73 ft ³ /kVA) 1200 lb	(1.73 ft ³ /kVA) 1200 lb	(1.16 ft ³ /kVA) 1750 lb
Voltage Req	(44 lb/kVA) 18	(32 lb/kVA) 18	(32 lb/kVA) 18	(31.1 lb/kVA) 18
Frequency Regulation	0.1%	0.1%	0.1%	0.1%
Harmonic Distortion	5%	5%	5%	5%
Environment	0 to 50°C 95%RH	0 to 50°C 95%RH	0 to 50°C 95%RH	0 to 50°C 95%RH

UNINTERRUPTIBLE POWER SUPPLIES
60kW < P <

Table 4. (Continued).

Company	Exide Electronics	Exide Electronics	Exide Electronics	Exide Electronics
Model	3100	5100	5150	3180
Rating	100kW, 125kVA	100kW	150kW, 187kVA	180kW, 225kVA
Input	208 or 480 or 600VAC 3 phase, 60Hz	204 or 380 or 400 or 415VAC, 3 phase, 50Hz	204 or 380 or 400 or 415VAC, 3 phase, 50Hz	208 or 480 or 600VAC 3 phase, 60Hz
Output	120/208 or 277/480 or 346/600VAC 3 phase, 60Hz	118/204 or 220/380 or 230/400 or 240/415VAC 3 phase, 50Hz	118/204 or 220/380 or 230/400 or 240/415VAC 3 phase, 50Hz	120/208 or 277/480 or 346/600VAC 3 phase, 60Hz
Size	32 X 126.6 X 82H	40.5 X 126.5 X 82H	40.5 X 126.5 X 82H	32 X 126.6 X 82H
(1.54 ft ³ /kVA)	(2.43 ft ³ /kVA)	(1.3 ft ³ /kVA)	(1.3 ft ³ /kVA)	(0.854 ft ³ /kVA)
Weight	6550 lb	8533 lb	10496 lb	8460 lb
(52.4 lb/kVA)	(85.3 lb/kVA)	(56.1 lb/kVA)	(56.1 lb/kVA)	(37.6 lb/kVA)
Voltage Reg	1%	1%	1%	1%
Frequency Regulation	±0.06Hz	±0.05Hz	±0.05Hz	±0.06Hz
Harmonic Distortion	5%	5%	5%	5%
Environment	0 to 40°C 95%RH	0 to 40°C 95%RH	0 to 40°C 95%RH	0 to 40°C 95%RH

UNINTERRUPTIBLE POWER SUPPLIES
 $60\text{kW} < P \leq$

Table 4. (Continued).

Company	Exide Electronics	Exide Electronics	Exide Electronics	Exide Electronics
Model				
5200	3250	5300	3330	
Rating				
Input	200kW, 250kVA	250kW, 313kVA	300kW, 375kVA	330kW, 412kVA
Output	204 or 380 or 400 or 415VAC, 3 phase, 50Hz	208 or 480 or 600VAC 3 phase, 60Hz	204 or 380 or 400 or 415VAC, 3 phase, 50Hz	208 or 480 or 600VAC 3 phase, 60Hz
Size	40.5 x 126.5 x 82H (0.972 ft ³ /kVA)	40 x 126.6 x 82H (0.768 ft ³ /kVA)	40.5 x 189 x 82H (0.97 ft ³ /kVA)	32 x 189.3 x 82H (0.70 ft ³ /kVA)
Weight	12392 lb	11130 lb	15876 lb	11730 lb
Voltage Reg	(49.6 lb/kVA)	(35.6 lb/kVA)	(42.3 lb/kVA)	(28.5 lb/kVA)
Frequency Regulation	$\pm 0.05\text{Hz}$	$\pm 0.06\text{Hz}$	$\pm 0.05\text{Hz}$	$\pm 0.06\text{Hz}$
Harmonic Distortion	5%	5%	5%	5%
Environment	0 to 40°C 95%RH 4000 ft	0 to 40°C 95%RH	0 to 40°C 95%RH 4000 ft	0 to 40°C 95%RH

UNINTERRUPTIBLE POWER SUPPLIES
 $60\text{kW} < P \leq$

Table 4. (Continued).

Company	Exide Electronics	Exide Electronics	Exide Electronics
Model			
Rating	3400	3450	3500
Input	400kW, 500kVA	450kW, 500kVA	500kW, 625kVA
Output	208 or 480 or 600VAC 3 phase, 60Hz	208 or 480 or 600VAC 3 phase, 60Hz	380VAC, 3 phase, 50Hz
Size	32 x 189.3 x 82H (0.575 ft ³ /kVA)	32 x 189.3 x 82H (0.575 ft ³ /kVA)	40.5 x 189 x 82H (0.581 ft ³ /kVA)
Weight	13260 lb (26.5 lb/kVA)	14100 lb (28.2 lb/kVA)	22094 lb (35.4 lb/kVA)
Voltage Reg	1%	1%	1%
Frequency Regulation	$\pm 0.06\text{Hz}$	$\pm 0.06\text{Hz}$	$\pm 0.05\text{Hz}$
Harmonic Distortion	5%	5%	5%
Environment	0 to 40°C 95%RH	0 to 40°C 95%RH	0 to 40°C 95%RH

UNINTERRUPTIBLE POWER SUPPLIES
 $60\text{ kVA} < P \leq$

Table 4. (Continued).

Company	Franklin Electric	Franklin Electric	Franklin Electric	Franklin Electric
Model				
575	5100	5125	5150	
Rating				
75kVA	100kVA	125kVA	150kVA	
Input				
380 or 400 or 415VAC 3 phase, 50Hz				
Output				
380 or 400 or 415VAC 3 phase, 50Hz				
Size	36 x 72 x 72H			
	(1.44 ft ³ /kVA)	(1.08 ft ³ /kVA)	(0.864 ft ³ /kVA)	(0.72 ft ³ /kVA)
Weight	4700 lb	5300 lb	5600 lb	6000 lb
	(62.7 lb/kVA)	(53 lb/kVA)	(44.8 lb/kVA)	(40 lb/kVA)
Voltage Reg	1%	1%	1%	1%
Frequency Regulation	0.5%	0.5%	0.5%	0.5%
Harmonic Distortion	5%	5%	5%	5%
Environment				
	32 to 104°F 95%RH 3300 ft			

UNINTERRUPTIBLE POWER SUPPLIES
60kW < P <

Table 4. (Continued).

Company	Franklin Electric	Franklin Electric	Franklin Electric
Model	675	6100	6125
Rating	75kVA	100kVA	125kVA
Input	120 or 208 or 277 or 480VAC, 3 phase, 60Hz	120 or 208 or 277 or 480VAC, 3 phase, 60Hz	120 or 208 or 277 or 480VAC, 3 phase, 60Hz
Output	120 or 208 or 277 or 480VAC, 3 phase, 60Hz	120 or 208 or 277 or 480VAC, 3 phase, 60Hz	120 or 208 or 277 or 480VAC, 3 phase, 60Hz
Size	36 x 72 x 72H (1.44 ft ³ /kVA)	36 x 72 x 72H (1.08 ft ³ /kVA)	36 x 72 x 72H (0.864 ft ³ /kVA)
Weight	4700 lb (62.7 lb/kVA)	5300 lb (53 lb/kVA)	5600 lb (44.8 lb/kVA)
Voltage Reg	1%	1%	1%
Frequency Regulation	0.5%	0.5%	0.5%
Harmonic Distortion	5%	5%	5%
Environment	32 to 104°F 95%RH 3300 ft	32 to 104°F 95%RH 3300 ft	32 to 104°F 95%RH 3300 ft

UNINTERRUPTIBLE POWER SUPPLIES
 $60\text{kW} < P <$

Table 4. (Continued).

Company	Teledyne Inet Series 100	Teledyne Inet Series 125	Teledyne Inet Series 150	Teledyne Inet Series 200
Model	\$47206 (\$0.47/VA)	\$49636 (\$0.40/VA)	\$52065 (\$0.35/VA)	\$56925 (\$0.28/VA)
Rating	80kW, 100kVA	100kW, 125kVA	120kW, 150kVA	160kW, 200kVA
Input	208 or 480v, 60Hz			
Output				
Size	60 x 36 x 85.5H (1 ft ³ /kVA)	60 x 36 x 90.5H (0.9 ft ³ /kVA)	60 x 36 x 90.5H (0.75 ft ³ /kVA)	72 x 34 x 96H (0.68 ft ³ /kVA)
Weight	4900 lb (49 lb/kVA)	5500 lb (44 lb/kVA)	6200 lb (41 lb/kVA)	6800 lb (34 lb/kVA)
Voltage Reg	$\pm 1\%$	$\pm 1\%$	$\pm 1\%$	$\pm 1\%$
Frequency Regulation	$\pm .05\%$	$\pm .05\%$	$\pm .05\%$	$\pm .05\%$
Harmonic Distortion	5%	5%	5%	5%
Environment	0-40°C 0-95%RH 0-5,000' elevation NEMA I enclosure			

UNINTERRUPTIBLE POWER SUPPLIES
60kW < P <

Table 4. (Continued).

Company	Teledyne Inet Series 250	Teledyne Inet Series 300	Teledyne Inet Series 375	Exide Electronics
Model	\$57745 (\$0.23/VA)	\$59585 (\$0.20/VA)	\$61775 (\$0.16/VA)	4080
Rating	200kW, 250kVA	240kW, 300kVA	300kW, 375kVA	80kW, 100kVA
Input	208 or 480v, 60Hz	208 or 480v, 60Hz	208 or 480v, 60Hz	208 or 480 or 600 280 or 415VAC 3 phase, 50 or 60Hz
Output				120/208VAC, 3 phase 400 or 415 or 440Hz
Size	72 x 34 x 96H (0.54 ft ³ /kVA)	72 x 34 x 96H (0.45 ft ³ /kVA)	72 x 34 x 96H (0.36 ft ³ /kVA)	32 x 64 x 82H (0.911 ft ³ /kVA)
Weight	7500 lb (30 lb/kVA)	8100 lb (27 lb/kVA)	9500 lb (25 lb/kVA)	4300 lb (43 lb/kVA)
Voltage Reg	$\pm 1\%$	$\pm 1\%$	$\pm 1\%$	1%
Frequency Regulation	$\pm .05\text{Hz}$	$\pm .05\text{Hz}$	$\pm .05\text{Hz}$	$\pm 1\text{Hz}$
Harmonic Distortion	5% (output) 10% (input)	5% (output) 10% (input)	5% (output) 10% (output)	5%
Environment	0-45°C 0-95%RH 0-5,000' elevation NEMA I enclosure			0 to 40°C 95%RH

UNINTERRUPTIBLE POWER SUPPLIES
60 < P <

Table 4. (Continued).

Company	Franklin Electric	Franklin Electric
Model	5200	6200
Rating	200kVA	200kVA
Input	380 or 400 or 415VAC 3 phase, 50Hz	120 or 208 or 277 or 480 or 600VAC 3 phase, 60Hz
Output		120 or 208 or 277 or 480 or 600VAC 3 phase, 60Hz
Size	36 x 72 x 72H	36 x 72 x 72H
Weight	(0.54 ft ³ /kVA) 6600 lb	(0.54 ft ³ /kVA) 6600 lb
Voltage Reg	(33 lb/kVA) 1%	(33 lb/kVA) 1%
Frequency Regulation	0.5%	0.5%
Harmonic Distortion	5%	5%
Environment	32 to 104°F 95%RH 3300 ft	32 to 104°F 95%RH 3300 ft

In the power ranges 15 kW to 60 kW and 60 kW and above, there are several models by Gould, Teledyne Inet and Elgar which meet the precise power voltage and frequency regulation specifications of MIL-STD-1332. These models are single frequency in and out and are specified for an operating temperature range of 0° C to 40° C by Gould and Teledyne and 0° C to 50° C by Elgar. Teledyne Inet states that its models (series 75 through 500) are not adaptable to field use in rough terrains.

Basically, these units are intended for fixed installation and are for single-purpose applications. Weight to power ratios are shown in Figure 2 (these figures do not include the standby energy source.).

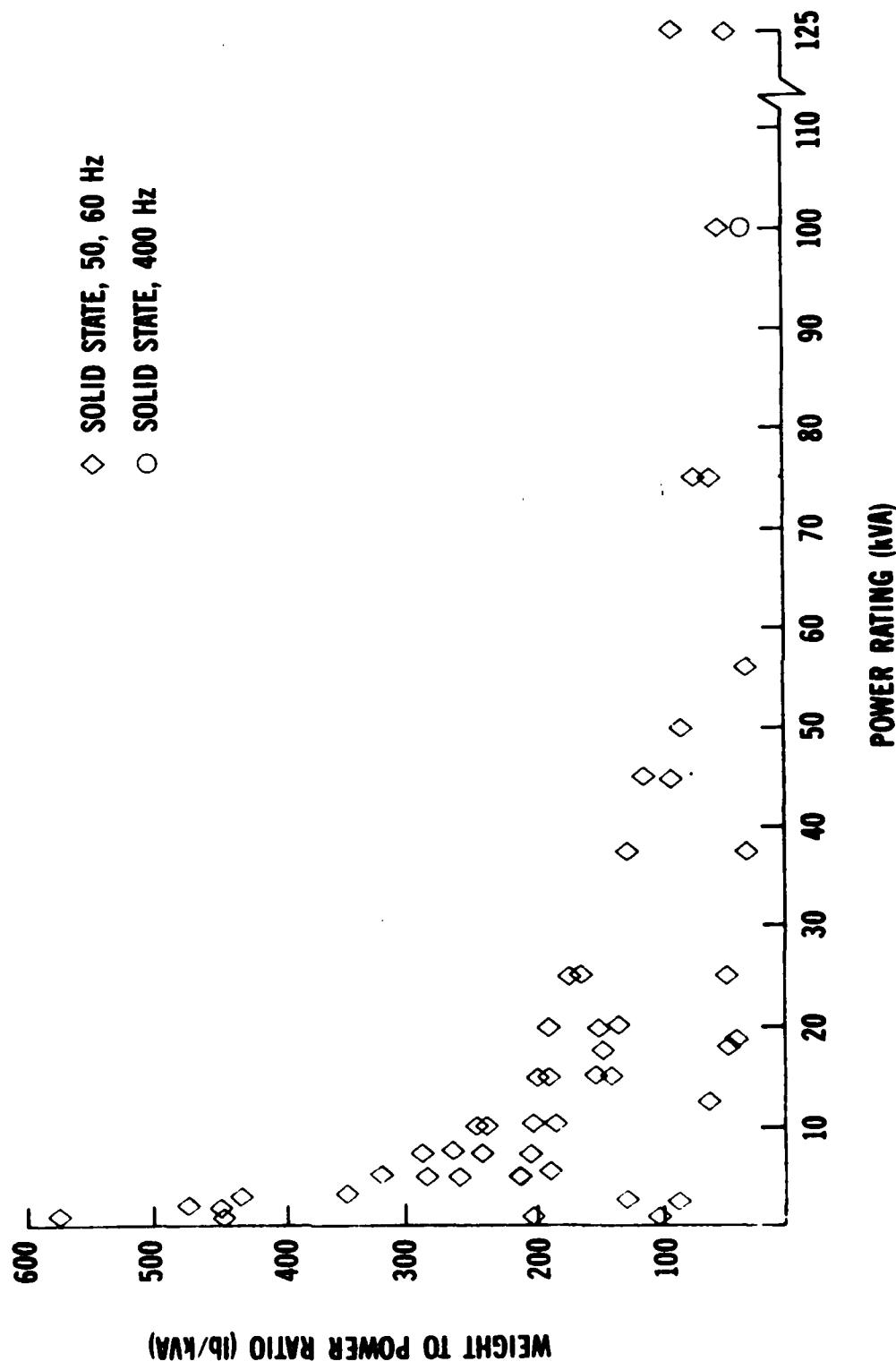


Figure 2. Weight to power rating ratio of uninterruptible power supplies vs power rating.

5. Frequency Changers (Table 5). Frequency changers are used to convert power available at one frequency to a different frequency required by the using equipment. Examples include supply of 400-Hz aircraft power from 60-Hz ground sources or conversion of 50 Hz to 60 Hz for equipment utilization in Europe and other OCONUS Theaters. The equipment reported here falls into two general categories: solid state static changers such as rectifier-inverter combinations and rotating machinery, such as motor-generator (MG) sets.

As a class, the MG sets tend to be heavier at a given power level than the solid state units, as shown in Figure 3. A similar relative trend is seen in the volume data, as shown in Figure 4.

The MG sets reported here are designed for single frequency in and out. In many cases, the output frequency is not controlled: In units based on synchronous machines, variations in the input frequency appear at the output. Except for d.c. motor control, this type of equipment does not lend itself to multi-input frequency designs.

Solid state systems in this category are designed for single frequency in and out, almost exclusively. A few solid state systems allow for a choice of frequency on order. They are intended for single-purpose application.

In the less than 5-kW power range, one unit from Teledyne Inet (CV-3231/V2) is built to military specifications. However, voltage regulation is ± 4 percent, outside precise requirements of MIL-STD 1332 but within the 4-percent utility power definition. Its weight to power ratio is about 40 lb/kVA. The operating temperature range is -33°C to $+52^{\circ}\text{C}$. Nova Electric models such as FC12XX allow a range of input frequencies. California Instruments Models such as 3001TC permit a range of input and output frequencies. These units are, essentially, laboratory power supplies.

FREQUENCY CHANGERS
 $0 < P \leq 5\text{kW}$

Table 5.

Company	Aerospace Avionics	A.I.S. Electronics	A.I.S. Electronics	A.I.S. Electronics
Model 1		SMG-5-51	SMG-5-53	SMG-5-401
Rating	50 VA Freq Conv	4kW	4kW	4kW
Input	0.05kVA	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz
Output				
Size	115 VAC, 400Hz 6 5/8 x 8 x 1 1/4H	120v, 1 phase 50 or 60Hz 25 x 17 x 21H	120v, 1 phase 266/460v 50 to 60Hz 25 x 17 x 21H	120v, 1 phase, 400Hz 21.5 x 17 x 14H
Weight	(0.77 ft ³ /kVA) 14.5 lb (290 lb/kVA)	(1.04 ft ³ /kVA) 450 (485 parallelable) 1b (90 lb/kVA)	(1.04 ft ³ /kVA) 480 (510 parallelable) 1b (96 lb/kVA)	(0.6 ft ³ /kVA) 155 (170 parallelable) 1b (31 lb/kVA)
Voltage Reg	2%	1%	1%	0.5%
Frequency Regulation	1%	.01%	.01%	.01%
Harmonic Distortion	5% (output)	2% (output)	2% (output)	2% (output)
Environment	0-40°C Driproof	0-40°C 0-95%RH Noncondensing	0-40°C 0-95%RH Noncondensing	0-40°C 0-95%RH Noncondensing

FREQUENCY CHANGER
 $0 < P \leq 5\text{kW}$

Table 5. (Continued).

Company	California Instruments	California Instruments	California Instruments	California Instruments
Model	251TC	251TC	351TC	501TC
Rating	0.25kVA	0.25kVA	0.35kVA	0.5kVA
Input	115 or 208 or 220 or 230 or 240VAC 1 phase, 48 to 65Hz	115 or 208 or 220 or 230 or 240VAC 1 phase, 48 to 65Hz	115 or 208 or 220 or 230 or 240VAC 1 phase, 48 to 65Hz	115 or 208 or 220 or 230 or 240VAC 1 phase, 48 to 65Hz
Output				
Size	0-30 or 0-75 or 0-135VAC, 45 to 20,000Hz	0-135 or 0-270VAC 45 to 5,000Hz	0-120 or 0-240VAC 45 to 5,000Hz	0-135 or 0-270VAC 45 to 5,000Hz
	21 x 19 x 5 1/4H	21 x 19 x 5 1/4H	21 x 19 x 5 1/4H	21 x 19 x 7H
(4.85 ft ³ /kVA)	(4.85 ft ³ /kVA)	(3.46 ft ³ /kVA)	(3.23 ft ³ /kVA)	
Weight	60 lb	70 lb	70 lb	100 lb
	(240 lb/kVA)	(280 lb/kVA)	(200 lb/kVA)	(200 lb/kVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion	0.9%	0.9%	0.9%	0.9%
Environment				
	-55 to 71°C	-55 to 71°C	-55 to 71°C	-55 to 71°C

FREQUENCY CHANGER
 $0 < P \leq 5\text{kW}$

Table 5. (Continued).

Company	California Instruments	California Instruments	California Instruments	California Instruments
Model	751TC	1001TC	1501TC	2501T
Rating	0.75kVA	1kVA	1.5kVA	2.5kVA
Input	115 or 208 or 220 or 230 or 240VAC 1 phase, 48 to 65Hz	115 or 208 or 220 or 230 or 240VAC 1 phase, 48 to 65Hz	115 or 210 or 250VAC 1 phase, 48 to 65Hz	208 or 220 or 370 or 416 or 440 or 460VAC 3 phase, 48 to 65Hz
Output				0-32.5 or 0-65 or 0-130 or 0-260VAC 45 to 5000Hz
Size	21 x 19 x 7H (2.16 ft ³ /kVA)	21 x 19 x 8 3/4H (2.02 ft ³ /kVA)	21 x 19 x 14H (2.16 ft ³ /kVA)	21 x 19 x 15 3/4H (1.45 ft ³ /kVA)
Weight	100 lb (133 lb/kVA)	140 lb (140 lb/kVA)	180 lb (120 lb/kVA)	240 lb (96 lb/kVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion	0.9%	0.9%	0.9%	0.9%
Environment				
	-55 to 71°C	-55 to 71°C	-55 to 71°C	-55 to 71°C

FREQUENCY CHANGER
 $0 < P \leq 5\text{kW}$

Table 5. (Continued).

Company	California Instruments	Nova Electric	Nova Electric
Model	FC12XX	FC25XX	FC50XX
Rating	3kVA	0.125kVA	0.25kVA
Input	115 or 208 or 220 or 230 or 240VAC 3 phase, 48 to 65Hz	115 or 220 or 240VAC 48 to 440Hz	115 or 220 or 240VAC 48 to 440Hz
Output	0-32.5 or 0-65 or 0-130 or 0-260VAC 45 to 2000Hz	115 or 220 or 240VAC 1 phase, 50 or 60 or 400 11 x 9 x 5 7/32H	115 or 220 or 240VAC 1 phase, 50 or 60 or 400 15 1/4 x 14 1/4 x 6 7/8H
Size	21 x 19 x 15 3/4H (1.21 ft ³ /kVA)	(2.39 ft ³ /kVA)	(3.46 ft ³ /kVA)
Weight	240 lb (80 lb/kVA)	30 lb (240 lb/kVA)	65 lb (260 lb/kVA)
Voltage Reg	1 ⁸	1 ⁸	1 ⁸
Frequency Regulation	0.15%	0.15%	0.15%
Harmonic Distortion	0.9%	4%	4%
Environment	-55 to 71°C	-20 to 50°C	-20 to 50°C
			-20 to 50°C

X denotes output frequency

FREQUENCY CHANGER
 $0 < P \leq 5\text{kW}$

Table 5. (Continued).

Company	Nova Electric	Nova Electric	Nova Electric	Nova Electric
Model	FC1KXX	FC1K400	FC2KXX	FC3KXX
Rating	1kVA	1kVA	2kVA	3kVA
Input	115 or 220 or 240VAC 48 to 440Hz	115 or 220 or 240VAC 48 to 440Hz	115 or 220 or 240VAC 48 to 440Hz	115 or 220 or 240VAC 48 to 440Hz
Output				
Size	17 x 17 x 8 3/4H (1.44 ft ³ /kVA)	115 or 220 or 240VAC 1 phase, 50 or 60Hz 15 1/4 x 14 1/4 x 6 7/8H (0.865 ft ³ /kVA)	115 or 220 or 240VAC 1 phase, 400Hz 19 x 19 x 14H (1.46 ft ³ /kVA)	115 or 220 or 240VAC 1 phase, 50 or 60 or 400 19 x 19 x 14H (0.975 ft ³ /kVA)
Weight	140 lb (140 lb/kVA)	73 lb (73 lb/kVA)	72.7 lb (36.4 lb/kVA)	120 lb (40 lb/kVA)
Voltage Reg	1%	1%	1%	1%
Frequency Regulation	0.15%	0.15%	0.15%	0.15%
Harmonic Distortion Environment	4%	4%	4%	4%
	-20 to 50°C	-20 to 50°C	-20 to 50°C	-20 to 50°C
	X denotes output frequency			

FREQUENCY CHANGERS
 $0 < P \leq 5\text{kW}$

Table 5. (Continued).

Company	A.L.S. Electronics	Bogue	Teledyne Inet	Teledyne Inet
Model	SMG-5-403	7330 (MG Set)	CV-3231/V-2	RHG 66-005 (MG Set)
Rating	4kW	5kW, 6.25kVA	4kW, 5kVA	5kW, 6.25kVA
Input	120/208 and/or 277/480 60Hz or 220/380 50Hz	220v, 3 phase, 60Hz	120/208v 4 wire 60Hz	480v 3 wire 60Hz
Output	120/208v or 120Y or 450 or 120 400Hz	115/220, 3 phase, 40Hz	120/208v 4 wire 400Hz	200v 4 wire 400Hz
Size	21.5 x 17 x 14H (0.6 ft ³ /kVA)		19 x 74 x 17 1/2H (2.8 ft ³ /kVA)	39 x 40 x 56H (8 ft ³ /kVA)
Weight	165 (190 parallelable) 1b (33 1b/kVA)	550 1b	200 1b (40 1b/kVA)	1700 1b (272 1b/kVA)
Voltage Reg	0.5%	1%	$\pm 4\%$	0.5%
Frequency Regulation	.01%		+0.3%	Synchronous with input frequency
Harmonic Distortion	2% (output)	2% (output)	3% (output)	1.5% (output)
Environment	0-40°C 0-95%RH Noncondensing		-33 to 52°C 90%RH 8,000 ft elevation Drip-proof	0°C to 50°C 10% to 95%RH 0 to 3,300 ft elevation

FREQUENCY CHANGERS
 $0 < P \leq 5\text{kW}$

Table 5. (Continued).

Company	Teledyne Inet	Unitron	Unitron	Unitron
Model				
RHG 64-005 (MG Set)	PS-65-225-8	PS-69-359	CR-024-3	
Rating	5kW, 6.75kVA	0.4kVA	2.0kVA	2.5kVA
Input	480v 3 wire 60Hz	115/200v, 400Hz	115/200v, 400Hz	120/208v, 50/60Hz
Output	200v 4 wire 400Hz	115v, 60Hz	115v, 50/60Hz	120/208v, 400Hz
Size	39 x 40 x 56H			24 x 19 x 17.5H
Weight	1700 lb (252 lb/kVA)	27 lb (67.5 lb/kVA)	80 lb (40 lb/kVA)	255 lb (102 lb/kVA)
Voltage Reg	0.5%	115 \pm 5.75 V RMS	115 \pm 3.0 V RMS	\pm 2%
Frequency Regulation	Synchronous with input frequency	60 \pm 0.6Hz	60 \pm 0.6Hz	400 \pm 2Hz
Harmonic Distortion	1.5% (output)	5% (at load) output 8% (no load) output	5% (output)	2.0% (output)
Environment				
	0°C to 50°C 10% to 95%RH 0 to 3,300 ft elevation			

FREQUENCY CHANGERS
 $0 < P \leq 5\text{kw}$

Table 5. (Continued).

Company	Unitron	Unitron	California Instruments	California Instruments
Model	PS-62-66D			
	\$6885 (\$1.97/kVA)	CR-054-3	153T	161T
Rating		5.0kVA	0.15kVA	0.16kVA
Input	3.5kVA			
	115/200V, 400Hz	120/208V, 50/60Hz	115 or 208 or 220 or 230 or 240VAC 1 phase, 48 to 65Hz	115 or 208 or 220 or 230 or 240VAC 1 phase, 48 to 65Hz
Output				
	115V, 60Hz	120/208V, 400Hz	0 -30 or 0-52 0-130 or 0-225VAC 3 phase, 45 to 20,000Hz	0-120VAC 45 to 5000Hz
Size		24 x 19 x 17.5H	21 x 19 x 5 1/4H	21 x 19 x 3 1/2H
Weight	95 lb	255 lb	70 lb	35 lb
	(27 lb/kVA)	(51 lb/kVA)	(467 lb/kVA)	(219 lb/kVA)
Voltage Reg	115 \pm 3.0 V RMS	\pm 2%		
Frequency Regulation	60 \pm 0.6Hz	400 \pm 2Hz		
Harmonic Distortion	5% (output)	2.0% (output)	0.9%	0.9%
Environment			-55 to 71°C	-55 to 71°C

FREQUENCY CHANGERS
 $0 < P \leq 5 \text{ kVA}$

Table 5. (Continued).

Company	KGS Electronics	KGS Electronics	KGS Electronics	KGS Electronics
Model	SPC 6-300F	SPC 6-750	SPC 6-750-30	SPS 1308-30
Rating	.3kVA	.75kVA	.75kVA	1kVA
Input				
Output	115VAC, 50 to 1,000Hz	115VAC, 50 to 1,000Hz	115VAC, 50 to 1,000Hz	115 or 208VAC 3 phase, 400Hz
Size	17 x 13 x 7H	26 or 115VAC, 1 phase, 400Hz	120 or 208VAC, 3 phase, 400Hz	115VAC, 1 phase 60 to 64Hz
Weight	25 lb (2.98 ft ³ /kVA)	17 x 13 x 7H (1.19 ft ³ /kVA)	17 x 13 x 7H (1.19 ft ³ /kVA)	14 x 7 3/4 x 4H (0.25 ft ³ /kVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion	2%		2%	
Environment				
	-17 to 140°F	-17 to 140°F	-17 to 140°F	-65 to 160°F 55,000 ft

FREQUENCY CHANGER
 $0 < P \leq 5\text{kW}$

Table 5. (Continued).

Company	TOPAZ POWERMARK DIV.	Nova Electric	Nova Electric	Brown Boveri Cie
Model	2639			
	\$9290 (\$1.86/VA)	FC5XXX	FC5K3/X	TWK01551
Rating				
Input	5.0kVA	5kVA	5kVA	1.5kVA
Output	208 or 240 VAC 3 phase, 60 Hz	115 or 220 or 240VAC 48 to 440Hz	115 or 220 or 240VAC 48 to 440Hz	220VAC, 1 phase 50 or 60Hz
Size	230 VAC, 1 phase, 60 Hz 21 x 19 x 21H	115 or 220 or 240VAC 1 phase, 50 or 60 or 400 3 phase, 50 or 60 or 400	115 or 220 or 240VAC 3 phase, 50 or 60 or 400	20 to 220VAC, 3 phase 2.5 to 120Hz 130 x 240 x 300H mm
Weight	(0.97 ft ³ /kVA) 325 lb	(1.58 ft ³ /kVA) 177 lb	(2.57 ft ³ /kVA) 505 lb	(0.22 ft ³ /kVA) 4.6 kg
Voltage Reg	(65 lb/kVA) 2%	(35.4 lb/kVA) 1%	(101 lb/kVA) 1%	(6.76 lb/kVA) 0.15%
Frequency Regulation	0.5%	0.15%		
Harmonic Distortion	5%	4%	4%	
Environment	0 to 55°C 0 to 90%RH	-20 to 50°C	-20 to 50°C	-10 to 40°C

X denotes output frequency

FREQUENCY CHANGER
 $0 < P \leq 5\text{kw}$

Table 5. (Continued).

Company	Brown Boveri Cie	Brown Boveri Cie	California Instruments	California Instruments
Model	TKW 02551	TKW 03551	503T	1503T
Rating	2.5 kVA	3.5 kVA	0.5 kVA	1.5 kVA
Input	220VAC, 1 phase 50 or 60Hz	220VAC, 1 phase 50 or 60Hz	115 or 208 or 220 or 230 or 240 VAC 1 phase, 48 to 65 Hz	208 or 220 or 230 or 370 or 416 or 440 or 460 VAC, 3 phase 48 to 65 Hz
Output			0 to 52 or 0 to 78 or 0 to 130 or 0 to 234 VAC 3 phase, 45 to 10000 Hz	0 to 130 or 0 to 234 VAC 45 to 5000 Hz
Size	165 x 240 x 300H mm (0.168 ft ³ /kVA)	180 x 300 x 340H mm (0.185 ft ³ /kVA)	21 x 19 x 8 3/4H (4.04 ft ³ /kVA)	21 x 19 x 14H (2.16 ft ³ /kVA)
Weight	5.3 kg (4.67 lb/kVA)	8.8 kg (5.54 lb/kVA)	100 lb (220 lb/kVA)	200 lb (133 lb/kVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion Environment			0.9%	0.9%
	-10 to 40°C	-10 to 40°C	-55 to 71°C	-55 to 71°C

FREQUENCY CHANGER
 $0 < P \leq 5\text{kW}$

Table 5. (Continued).

Company	TOPAZ POWERMARK DIV.	TOPAZ POWERMARK DIV.	TOPAZ POWERMARK DIV.	TOPAZ POWERMARK DIV.
Model	2561	2630	2631	2736
	\$9125 (\$1.82/VA)	\$6630 (\$3.32/VA)	\$6630 (\$3.32/VA)	\$9855 (\$2.46/VA)
Rating				
Input	5.0kVA	2.0kVA	2.0kVA	4.0kVA
Output	115 or 230 VAC, 60 Hz	208 or 240 VAC 3 phase, 50 Hz	208 or 240 VAC 3 phase, 50 Hz	208 or 240 VAC 3 phase, 50 Hz
Size	21 x 19 x 21H	21 x 19 x 14H	230 VAC, 1 phase, 50 Hz	115 VAC, 1 phase, 50 Hz
	(0.97 ft ³ /kVA)	(1 ft ³ /kVA)	21 x 19 x 14H	21 x 19 x 21H
Weight	325 lb	240 lb	240 lb	(1.21 ft ³ /kVA)
	(65 lb/kVA)	(120 lb/kVA)	(120 lb/kVA)	325 lb
Voltage Reg	2%	2%	2%	(81.2 lb/kVA)
Frequency Regulation	0.5%	0.5%	0.5%	2%
Harmonic Distortion Environment	5%	5%	5%	0.5%
	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH

FREQUENCY CHANGER
 $0 < P \leq 5\text{ kVA}$

Table 5. (Continued).

Company	TOPAZ POWERMARK DIV.	TOPAZ POWERMARK DIV.	TOPAZ POWERMARK DIV.	TOPAZ POWERMARK DIV.
Model	2643-23	1644	2634	1648-23
Rating	\$9855 (\$2.46/VA)	\$6140 (\$2.46/VA)	\$6140 (\$2.46/VA)	\$9290 (\$1.86/VA)
Input	4.0 kVA	2.5 kVA	2.5 kVA	5.0 kVA
Output	208 or 240 VAC 3 phase, 50 Hz	208 or 240 VAC 3 phase, 60 Hz	208 or 240 VAC 3 phase, 60 Hz	208 or 240 VAC 3 phase, 60 Hz
Size	21 x 19 x 21H (1.21 ft ³ /kVA)	21 x 19 x 14H (1.29 ft ³ /kVA)	21 x 19 x 14H (1.29 ft ³ /kVA)	21 x 19 x 21H (0.97 ft ³ /kVA)
Weight	325 lb	240 lb	240 lb	325 lb
Voltage Reg	28	28	28	28
Frequency Regulation	0.5%	0.5%	0.5%	0.5%
Harmonic Distortion	5%	5%	5%	5%
Environment	0 to 55°C 0 to 90%RH			

HD-R138 486

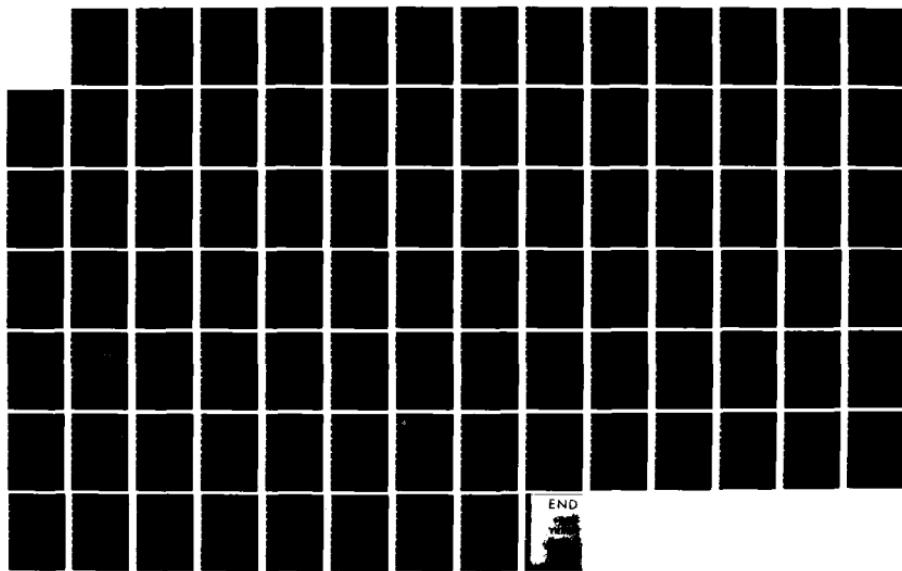
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ARMY BELVOIR RESEARCH AND DEVELOPMENT CENTER FORT
BELVOIR VA W D LEE DEC 83 BRDC-2395

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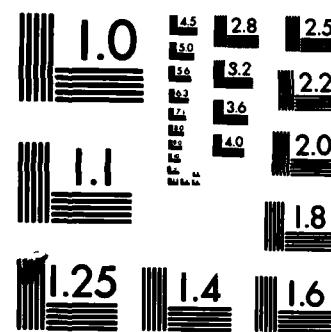
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10/2



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

FREQUENCY CHANGER
 $0 < P \leq 5\text{kW}$

Table 5. (Continued).

Company	TOPAZ POWERMARK DIV.	TOPAZ POWERMARK DIV.	TOPAZ POWERMARK DIV.	TOPAZ POWERMARK DIV.
Model	2735	1643-23	2591-23	1647-23
Rating	\$9855 (\$2.46/VA)	\$6140 (\$2.46/VA)	\$6140 (\$2.46/VA)	\$9290 (\$1.86/VA)
Input	4.0kVA	2.5kVA	2.5kVA	5.0kVA
Output	115 or 230 VAC, 50 Hz	115 or 230 VAC, 60 Hz	115 or 230 VAC, 60 Hz	115 or 230 VAC, 60 Hz
Size	21 x 19 x 21H (11.21 ft ³ /kVA)	21 x 19 x 14H (11.29 ft ³ /kVA)	21 x 19 x 14H (11.29 ft ³ /kVA)	21 x 19 x 21H (0.97 ft ³ /kVA)
Weight	325 lb	240 lb	240 lb	325 lb
Voltage Reg	2%	2%	2%	2%
Frequency Regulation	0.5%	0.5%	0.5%	0.5%
Harmonic Distortion	5%	5%	5%	5%
Environment	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH

FREQUENCY CHANGERS
 $5 < P \leq 15\text{kw}$

Table 5. (Continued).

Company	A.L.S. Electronics	A.L.S. Electronics	A.L.S. Electronics	A.L.S. Electronics
Model	SMG 7.5-51	SMG 7.5-53	SMG 15-401	SMG 15-403
Rating	6kW	6kW	12kW	12kW
Input	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz
Output				
Size	120v, 1 phase, 50/60Hz 25 x 17 x 24.5H	120v, 1 phase, 50/60Hz 25 x 17 x 24.5H	120v, 1 phase, 400Hz 21.5 x 17 x 17.5H	120/208 or 120vA, 450vA, 400Hz 21.5 x 17 x 17.5H
Weight	(0.8 ft ³ /kVA) 520 (600 parallelable) 1b (96 lb/kVA)	(0.8 ft ³ /kVA) 550 (630 parallelable) 1b (73 lb/kVA)	(0.25 ft ³ /kVA) 265 (285 parallelable) 1b (18 lb/kVA)	(0.25 ft ³ /kVA) 280 (310 parallelable) 1b (19 lb/kVA)
Voltage Reg	1%	1%	0.5%	0.5%
Frequency Regulation	0.01%	0.01%	.01%	.01%
Harmonic Distortion	2% (output)	2% (output)	1% (output)	1% (output)
Environment	0-40°C 0-95%RH Noncondensing	0-40°C 0-95%RH Noncondensing	0-40°C 0-95%RH Noncondensing	0-40°C 0-95%RH Noncondensing

FREQUENCY CHANGERS
 $5 < P \leq 15\text{kW}$

Table 5. (Continued).

Company	A.L.S. Electronics	A.L.S. Electronics	A.L.S. Electronics	Boque
Model	SMG 15-51	SMG 15-53	SMG 15M	8171 (MG Set)
Rating				
Input	12kW	12kW	12.5kW	10kW, 12.5kVA
Output	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz	120/208v, 45-65Hz	
Size	120/240v, 10 50/60Hz 25 x 17 x 45.5H	120/240v or 277/480v 50/60Hz	120/208v, 400Hz 25 x 17 x 45.5H	
Weight	(0.744 ft ³ /kVA) 790 (850 parallelable) 1b (53 1b/kVA)	(0.75 ft ³ /kVA) 850 (910 parallelable) 1b (57 1b/kVA)		1000 lb (80 lb/kVA)
Voltage Reg	1%		1%	1%
Frequency Regulation	0.01%	0.01%	0.01%	0.01%
Harmonic Distortion	2% (output)	2% (output)	2% (output) 10% (input)	2% (output)
Environment	0-40°C 0-95%RH Noncondensing	0-40°C 0-95%RH Noncondensing	-34 to 53°C 90%RH 0-8,000ft elevation Outdoor enclosure	

FREQUENCY CHANGER
 $5 < P \leq 15\text{ kW}$

Table 5. (Continued).

Company	Georator Corp	Georator Corp	Georator Corp	Georator Corp
Model	37-227 (MG Set)	37-312 (MG Set)	37-135 (MG Set)	37-285 (MG Set)
Rating	\$6000 (\$0.96/VA)	\$6000 (\$0.96/VA)	\$6800 (\$0.54/VA)	\$6800 (\$0.54/VA)
Input	6.25 kVA	6.25 kVA	12.5 kVA	12.5 kVA
Output	220 or 440 VAC 3 phase, 60 Hz	220 or 440 VAC 3 phase, 60 Hz	230 or 460 VAC 3 phase, 60 Hz	230 or 460 VAC 3 phase, 60 Hz
Size	48 x 20 x 30H	48 x 20 x 30H	62 x 22 x 30H	62 x 22 x 30H
Weight	(2.67 ft ³ /kVA) 700 lb	(2.67 ft ³ /kVA) 700 lb	(1.89 ft ³ /kVA) 950 lb	(1.89 ft ³ /kVA) 950 lb
Voltage Reg	(1112 lb/kVA) 18	(1112 lb/kVA) 18	(76 lb/kVA) 18	(76 lb/kVA) 18
Frequency Regulation				
Harmonic Distortion	5%	5%	5%	5%
Environment	40°C 3300 ft	40°C 3300 ft	40°C 3300 ft	40°C 3300 ft

FREQUENCY CHANGERS
 $5 < P \leq 15\text{kW}$

Table 5. (Continued).

Company	Boque	DECC	Powertronic Systems	Teledyne Inet
Model	8116 (MG Set)	61258		RHG 64-007 (MG Set)
Rating	15kW, 18.75kVA	10kVA		15kVA
Input		115/200v, 3 phase 47-63Hz	480VAC, 3 phase, 60Hz	7.5kW, 9.38kVA
Output			480V 3 wire 60Hz	
Size		115v, 1 phase, 60Hz	480VAC, 3 phase, 60Hz	200v 4 wire 400Hz
Weight	1400 lb	24 x 74 x 60H (6.2 ft ³ /kVA) 700 lb	24 x 30 x 21H (0.58 ft ³ /kVA) 150 lb	39 x 40 x 56H (5.4 ft ³ /kVA) 1700 lb
Voltage Reg	(75 1b/kVA)	(70 1b/kVA)	(10 1b/kVA)	(181 1b/kVA)
Frequency Regulation	1%	0.5Hz	1%	0.5%
Harmonic Distortion	2% (output)	5% (output)	3% (output)	1.5% (output)
Environment			65°C 100%RH	0°C to 50°C 10% to 95%RH 0 to 3,300ft elevation

FREQUENCY CHANGERS
 $5 < P \leq 15\text{kW}$

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model	RHG 64-010 (MG Set)	RHG 64-015 (MG Set)	RHG 65-010 (MG Set)	RHG 65-015 (MG Set)
Rating	10kW, 12.5kVA	15kW, 18.75kVA	10kW, 12.5kVA	15kW, 18.75kVA
Input	480v 3 wire 60Hz	480v 3 wire 60Hz	480v 3 wire 60Hz	480v 3 wire 60Hz
Output				
Size	39 x 40 x 56H (4 ft ³ /kVA)	39 x 40 x 56H (2.7 ft ³ /kVA)	44 x 63 x 70H (9 ft ³ /kVA)	44 x 63 x 70H (6 ft ³ /kVA)
Weight	1700 lb (136 lb/kVA)	1700 lb (91 lb/kVA)	3250 lb (200 lb/kVA)	3325 lb (177 lb/kVA)
Voltage Reg	0.5%	0.5%	0.5%	0.5%
Frequency Regulation	Synchronous with input frequency			
Harmonic Distortion	1.5% (output)	1.5% (output)	1.5% (output)	1.5% (output)
Environment	0°C to 50°C 10% to 95%RH 0 to 3,300ft elevation	0°C to 50°C 10% to 95%RH 0 to 3,300ft elevation	0°C to 50°C 10% to 95%RH 0 to 3,300ft elevation	0°C to 50°C 10% to 95%RH 0 to 3,300ft elevation

FREQUENCY CHANGERS
 $5 < P \leq 15\text{kW}$

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Uniftron
Model	R&G 66-007 (MG Set)	R&G 66-010 (MG Set)	R&G 66-015 (MG Set)	CR-074-3
Rating	7.5kW, 9.38kVA	10kW, 12.5kVA	15kW, 18.75kVA	7.5kVA
Input	480v 3 wire 60Hz	480v 3 wire 60Hz	480v 3 wire 60Hz	120/208v, 50/60Hz
Output				
Size	200v 4 wire 400Hz	200v 4 wire 400Hz	200v 4 wire 400Hz	120/208v, 400Hz
Weight	39 x 40 x 56H (5.3 ft ³ /kVA)	39 x 40 x 56H (4 ft ³ /kVA)	39 x 40 x 56H (2.7 ft ³ /kVA)	24 x 19 x 17.5H (0.62 ft ³ /kVA)
Voltage Reg	1700 lb (181 lb/kVA)	1700 lb (136 lb/kVA)	1700 lb (91 lb/kVA)	255 lb (34 lb/kVA)
Frequency Regulation	0.5%	0.5%	0.5%	400 ±2Hz
Harmonic Distortion	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency	400 ±2Hz
Environment	1.5% (output)	1.5% (output)	1.5% (output)	2.0% (output)
	0°C to 50°C 10% to 95%RH 0 to 3,300 ft elevation	0°C to 50°C 10% to 95%RH 0 to 3,300 ft elevation	0°C to 50°C 10% to 95%RH 0 to 3,300 ft elevation	

FREQUENCY CHAMBERS
5 < P \leq 15kW

Table 5. (Continued).

Company	Unitron	Unitron	Unitron	Unitron
Model	PR-41-33D	CR-104-3	CR-124-3	CR-154-3
Rating	8.0kVA	10.0kVA	12.5kVA	15.0kVA
Input	115/200V, 400Hz	120/208V, 50/60Hz	120/208V, 50/60Hz	120/208V, 50/60Hz
Output				
Size	115V, 60Hz	120/208V, 400Hz 25 x 19 x 31.5H (0.87 ft ³ /kVA)	120/208V, 400Hz 25 x 19 x 31.5H (0.7 ft ³ /kVA)	120/208V, 400Hz 25 x 19 x 31.5H (0.58 ft ³ /kVA)
Weight	250 lb	450 lb	450 lb	450 lb
Voltage Reg	$\pm 1.0\text{ V RMS}$	$\pm 2\%$	$\pm 2\%$	$\pm 2\%$
Frequency Regulation	0.0 $\pm 0.6\text{Hz}$	400 $\pm 2\text{Hz}$	400 $\pm 2\text{Hz}$	400 $\pm 2\text{Hz}$
Harmonic Distortion	5% (output)	2.0% (output)	2.0% (output)	2.0% (output)
Environment				

FREQUENCY CHANGERS
5 < P \leq 15kW

Table 5. (Continued).

Company	Varo	Nova Electric	Nova Electric	Nova Electric
Model	44—	FC10K3/X	FC7.5K3/X	FC10K3X
Rating	10kW	10kVA	7.5kVA	10kVA
Input	440v, 3 phase 3 wire 60Hz	115 or 220 or 240VAC 48 to 440Hz	115 or 220 or 240VAC 48 to 440Hz	115 or 220 or 240VAC 48 to 440Hz
Output				
Size	450v, 3 phase 3 wire 400Hz	120 or 208VAC, 3 phase 50 or 60 or 400Hz	120 or 208VAC, 3 phase 50 or 60 or 400Hz	115 or 220 or 240VAC 1 phase 50 or 60 or 400Hz
Weight		24 x 17 x 54 1/2H (1.29 ft ³ /kVA)	24 x 34 x 42 1/2H (2.68 ft ³ /kVA)	30 x 22 x 48H (1.83 ft ³ /kVA)
Voltage Reg	1%	1350 lb (135 lb/kVA)	785 lb (105 lb/kVA)	675 lb (67.5 lb/kVA)
Frequency Regulation		1%	1%	1%
Harmonic Distortion	2.5%	0.15%	0.15%	0.15%
Environment		48	48	48
				-20 to 50°C
				-20 to 50°C

X denotes output frequency

PROOF CHARGERS
5 < 15kW

Table 5. (Continued).

Company	Fluoy & Root Company	Nova Electric	Delco Electronics	Topaz Powermark Div
Model	MD2 (IG Set)	FC15K3/X		2720
Rating	15kW	15kVA	12kW	10kVA
Input	220 or 440VAC, 3 phase, 60Hz	115 or 220 or 240VAC 48 to 440Hz	120 or 208VAC 3 phase, 50 or 60Hz	208 or 240VAC 3 phase, 60Hz
Output				
Size	53 x 39 1/4 x 33H	120 or 208VAC, 3 phase 50 or 60 or 400Hz	120 or 208VAC 3 phase, 400Hz	230VAC, 1 phase, 60Hz
Weight	1625 lb	24 x 34 x 42 1/2H (2.65 ft ³ /kVA)	24 x 34 x 42 1/2H (1.34 ft ³ /kVA)	31 x 23 1/4 x 62H (2.59 ft ³ /kVA)
Voltage Reg		1055 lb	200 lb	850 lb
Frequency Regulation		(100.3 lb/kVA)	(16.7 lb/kVA)	(85 lb/kVA)
Harmonic Distortion Environment		18	28	5%
		0.15%	0.5%	
		4%		
				0 to 55OC
				95%RH
				-40 to 55OC
				125OF

X denotes output frequency

FREQUENCY CHANGER
 $5 < P \leq 15\text{kW}$

Table 5. (Continued).

Company	TOPAZ POWERMARK DIV.	Brown Boveri Cie	Brown Boveri Cie
Model	2697		
	\$18475 (\$1.85/kVA)	TWK 055553	TWK 11053
Rating			
Input	10.0kVA	5.5kVA	11kVA
			8.5kVA
Output			
Size	115 VAC, 1 phase, 60 Hz 31 x 23 1/4 x 62H	35 to 380VAC, 3 phase 2.5 to 120Hz 235 x 300 x 370H mm	35 to 380VAC, 3 phase 2.5 to 120Hz 235 x 320 x 450H mm
Weight	(2.59 ft ³ /kVA) 850 lb (85 lb/kVA)	(0.167 ft ³ /kVA) 13 kg (5.21 lb/kVA)	(0.108 ft ³ /kVA) 23 kg (4.61 lb/kVA)
Voltage Reg	2%		
Frequency Regulation	0.5%		
Harmonic Distortion	5%		
Environment			
	0 to 55°C 0 to 90%RH	-10 to 40°C	-10 to 40°C
			-10 to 40°C

FREQUENCY CHANGER
 $5 < P \leq 15\text{kW}$

Table 5. (Continued).

Company	TOPAZ POWERMARK DIV. 2732	TOPAZ POWERMARK DIV. 2707	TOPAZ POWERMARK DIV. 2731	TOPAZ POWERMARK DIV. 2771
Model	\$19955 (\$2.49/VA)	\$18475 (\$1.85/VA)	\$19955 (\$2.49/VA)	\$19955 (\$2.49/VA)
Rating	8.0 kVA	10.0 kVA	8.0 kVA	8.0 kVA
Input	230 VAC, 50 Hz	230 VAC, 60 Hz	208 or 240 VAC 3 phase, 50 Hz	208 or 240 VAC 3 phase, 50 Hz
Output				
Size	31 x 23 1/4 x 62H	31 x 23 1/4 x 60 Hz (2.59 ft ³ /kVA)	115 VAC, 1 phase, 50 Hz 31 x 23 1/4 x 62H (3.23 ft ³ /kVA)	115 VAC, 1 phase, 50 Hz 31 x 23 1/4 x 62H (3.23 ft ³ /kVA)
Weight	850 lb	850 lb	850 lb	850 lb
Voltage Reg	(106 1b/kVA)	(85 1b/kVA)	(106 1b/kVA)	(106 1b/kVA)
Frequency Regulation	0.5%	0.5%	0.5%	0.5%
Harmonic Distortion	5%	5%	5%	5%
Environment				
	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH	0 to 55°C 0 to 90%RH

FREQUENCY CHANGER
 $5 < P \leq 15 \text{ kW}$

Table 5. (Continued).

Company	California Instruments							
Model	15RT1							
Rating	15 kVA							
Input	208 VAC, 3 phase 48 to 65 Hz							
Output		0 to 130 or 0 to 260 VAC 45 to 2000 Hz						
Size		32 1/2 x 28 3/8 x 79 3/4 (2.82 ft ³ /kVA)						
Weight	1500 lb							
Voltage Reg		(100 lb/kVA)						
Frequency Regulation								
Harmonic Distortion	0.5%							
Environment		0 to 55°C						

FREQUENCY CHANGERS
 $15 < P \leq 60\text{kW}$

Table 5. (Continued).

Company	ABEX-JETWAY	ABEX-JETWAY	ABEX-JETWAY	Nova Electric
Model			60	
Rating	30	40	\$50000 (\$0.83/VA)	FC30K3/X
Input	30kVA	40kVA	60kVA	30kVA
Output	230V to 600V 30 50-60Hz	208 to 600V 30 50-60Hz	230-600VAC 30, 50-60Hz	115 or 220 or 240VAC 48 to 440Hz
Size	116/200V 3 phase, 400Hz	116/200V 3 phase, 400Hz	115/200 VAC 3 phase, 400Hz	120 or 208VAC, 3 phase 50 or 60 or 400Hz
Weight	64 x 54 x 16H	64 x 54 x 16H	64 x 54 x 16H	30 x 44 x 64H
Voltage ..eg	(1.07 ft ³ /kVA)	(0.8 ft ³ /kVA)	(0.533 ft ³ /kVA)	(1.63 ft ³ /kVA)
Frequency Regulation	$\pm 0.04\%$	$\pm 0.04\%$	$\pm 0.04\%$	0.15%
Harmonic Distortion	5%	5%	5%	4%
Environment				
	-40 to +55°C, 90% HC 5000 ft outdoor encl	-40 to +55°C, 90% HC 5000 ft outdoor encl	-40 to +55°C, 90% HC 5000 ft outdoor encl	-40 to +55°C, 90% HC 5000 ft outdoor encl
X	denotes output frequency			-20 to 50°C

FREQUENCY CHANGERS
 $15 < P \leq 60\text{kW}$

Table 5. (Continued).

Company	A.L.S. Electronics	A.L.S. Electronics	A.L.S. Electronics	A.L.S. Electronics
Model	SMG 30-51	SMG 30-53	SMG 30-401	SMG 30-403
Rating	24kW	24kW	24kW	24kW
Input	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz	120/208v and/or 277/480v, 60Hz or 220/380v, 50Hz
Output				
Size	120/240v, 1 phase 50/60Hz	120/208v or 277/480v 50/60Hz	120/208v and/or 120 or 450	120/208v or 120A or 450Δ
Weight	36 x 24 x 72H (1.2 ft ³ /kVA) 1110 (1225 parallelable) 1b (37 lb/kVA)	36 x 24 x 72H (1.2 ft ³ /kVA) 1200 (1330 parallelable) 1b (40 lb/kVA)	31.5 x 17 x 31.5H (0.33 ft ³ /kVA) 435 (475 parallelable) 1b (14.5 lb/kVA)	31.5 x 17 x 31.5H (0.33 ft ³ /kVA) 480 (530 parallelable) 1b (16.1 lb/kVA)
Voltage Reg	1%	1%	0.5%	0.5%
Frequency Regulation	0.01%	0.01%	0.01%	0.01%
Harmonic Distortion	2% (output)	2% (output)	1% (output)	1% (output)
Environment	0-40°C 0-95%RH Noncondensing	0-40°C 0-95%RH Noncondensing	0-40°C 0-95%RH Noncondensing	0-40°C 0-95%RH Noncondensing

FREQUENCY CHANGERS
15 < P \leq 60kW

Table 5. (Continued).

Company	Bogue	Bogue	Bogue	Bogue
Model	MD 3-7670 (MG Set)	MC 1A 7781 (MG Set)	75.89 (MG Set)	50kVA RCT (rotating transformer) \$18700 (\$0.37/VA)
Rating	20kW	30kW	30kW, 37.5kVA	50kVA
Input	60Hz	60Hz		380V, 2 phase, 50Hz
Output				
Size	400HZ	400HZ		480V, 3 phase, 60Hz
Weight				39 1/4 x 28 x 67H (0.85 ft ³ /kVA)
Voltage Reg				2800 lb
Frequency Regulation				1,800 lb (56 lb/kVA)
Harmonic Distortion				18
Environment				28 (output)

FREQUENCY CHANGER
15 < P \leq 60kW

Table 5. (Continued).

Company	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie
Model	BNK 01631	BNK 02531	BNK 03831	BNK 05631
Rating	16kVA	25kVA	38kVA	56kVA
Input	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz
Output				
Size	300 x 550 x 1250H mm (0.455 ft ³ /kVA)	300 x 550 x 1250H mm (0.291 ft ³ /kVA)	30 to 360VAC, 3 phase 5 to 150Hz (0.736 ft ³ /kVA)	30 to 360VAC, 3 phase 5 to 150Hz (0.499 ft ³ /kVA)
Weight	125 kg (17.2 lb/kVA)	140 kg (12.3 lb/kVA)	252 kg (14.6 lb/kVA)	350 kg (13.8 lb/kVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion Environment				
	-10 to 35°C	-10 to 35°C	-10 to 35°C	-10 to 35°C

FREQUENCY CHANGER
15 < P \leq 60kW

Table 5. (Continued).

Company	Georator Corp	Georator Corp	Georator Corp	Georator Corp
Model	37-136 (MG Set)	37-137 (MG Set)	37-139 (MG Set)	37-138 (MG Set)
	\$7200 (\$0.38/VA)	\$7200 (\$0.38/VA)	\$8000 (\$0.32/VA)	\$8000 (\$0.32/VA)
Rating	18.75 kVA	18.75 kVA	25 kVA	25 kVA
Input	230 or 460 VAC 3 phase, 60 Hz	230 or 460 VAC 3 phase, 60 Hz	230 or 460 VAC 3 phase, 60 Hz	230 or 460 VAC 3 phase, 60 Hz
Output				
Size	64 x 22 x 38H (1.65 ft ³ /kVA)	120 or 208 VAC, 60 Hz (1.43 ft ³ /kVA)	115 or 230 VAC, 60 Hz (1.52 ft ³ /kVA)	115 or 230 VAC, 60 Hz (1.52 ft ³ /kVA)
Weight	1200 lb	1300 lb	1550 lb	1550 lb
Voltage Reg	1%	1%	1%	1%
Frequency Regulation				
Harmonic Distortion	5%	5%	5%	5%
Environment	40°C 3300 ft	40°C 3300 ft	40°C 3300 ft	40°C 3300 ft

FREQUENCY CHANGERS
 $15 < P \leq 60\text{kW}$

Table 5. (Continued).

Company	Bogue	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model	PP60 (MG Set)	RHG 64-020 (MG Set)	RHG 64-030 (MG Set)	RHM 64-036 (MG Set)
Rating	60kW, 75kVA	20kW, 25kVA	30kW, 37.5kVA	36kW, 45kVA
Input				
		480v 3 wire 60Hz	480v 3 wire 60Hz	208v, 60Hz
Output				
		200v 4 wire 400Hz	200v 4 wire 400Hz	120/208v, 400Hz
Size		39 x 40 x 56H (2 ft ³ /kVA)	39 x 44 x 56H (1.5 ft ³ /kVA)	33 x 51 x 54H (1.2 ft ³ /kVA)
Weight	4500 lb (60 lb/kVA)	1700 lb (68 lb/kVA)	1900 lb (63 lb/kVA)	2700 lb (60 lb/kVA)
Voltage Reg	1%	0.5%	0.5%	0.5%
Frequency Regulation	1%	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency
Harmonic Distortion	2% (output)	1.5% (output)	1.5% (output)	1.5% (output)
Environment		0-50°C 10% to 95%RH 0 to 3,300 ft elevation	0-50°C 10% to 95%RH 0 to 3,300 ft elevation	-40°C to 50°C 0% to 100%RH 0 to 3,300 ft elevation Outdoor enclosure

FREQUENCY CHANGERS
 $15 < P \leq 60\text{kW}$

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model	RHG 64-040 (MG Set)	RHG 64-060 (MG Set)	RHG 66-020 (MG Set)	RHG 66-030 (MG Set)
Rating	40kW, 50kVA	60kW, 75kVA	20kW, 25kVA	30kW, 37.5kVA
Input	480v 3 wire 60Hz	480v 3 wire 60Hz	480v 3 wire 60Hz	480v 3 wire 60Hz
Output				
Size	45 x 47 x 68H (1.7 ft ³ /kVA)	45 x 47 x 68H (1.1 ft ³ /kVA)	39 x 40 x 56H (2 ft ³ /kVA)	39 x 40 x 56H (1.3 ft ³ /kVA)
Weight	2500 lb (50 lb/kVA)	2800 lb (37 lb/kVA)	1700 lb (68 lb/kVA)	1700 lb (45 lb/kVA)
Voltage Reg	0.5%	0.5%	0.5%	0.5%
Frequency Regulation	Synchronous with input frequency			
Harmonic Distortion	1.5% (output)	1.5% (output)	1.5% (output)	1.5% (output)
Environment	0-50°C 10% to 95%RH 0 to 3,300 ft elevation			

FREQUENCY CHANGERS
 $15 < P \leq 60\text{kW}$

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model	RHG 66-040 (MG Set)	MG 1A (MG Set)	MD-4 (MG Set)	RHG 66-060 (MG Set)
Rating	40kW, 50kVA	48kW, 60kVA	48kW, 60kVA	60kW, 75kVA
Input	480V 3 wire 60Hz	220/440V, 60Hz	120/208, 3 phase, 60Hz	480V 3 wire 60Hz
Output				
Size	200V 4 wire 400Hz 39 x 44 x 56H (1.1 ft ³ /kVA)	115/200, 28VDC 400Hz 85 x 49 x 41H (1.65 ft ³ /kVA)	WYE 208 L/L, 120 L/N Delta, 120 L/L 400Hz 96 x 45 x 40H (1.67 ft ³ /kVA)	200V 4 wire 400Hz 45 x 47 x 68H (1.1 ft ³ /kVA)
Weight	1900 lb (38 lb/kVA)	4120 lb (69 lb/kVA)	3500 lb (58 lb/kVA)	2500 lb (33 lb/kVA)
Voltage Reg	0.5%	0.5%	1.0%	0.5%
Frequency Regulation	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency
Harmonic Distortion	1.5% (output)	1.5% (output)	2.0% (output)	1.5% (output)
Environment	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation	-40°C to 50°C 0% to 100%RH 0 to 3,300 ft elevation	-46°C to 55°C 0% to 100%RH 0 to 3,300 ft elevation	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation

FREQUENCY CHANGERS
 $15 < P \leq 60\text{kW}$

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model	RHG 64-060 (MG Set)	RHG 66-060 (MG Set)	RHG 65-020 (MG Set)	RHG 65-025 (MG Set)
Rating	60kW, 75kVA	60kW, 75kVA	20kW, 25kVA	25kW, 31.25kVA
Input	480/380V 60Hz	480V 3 wire 60Hz	480V 3 wire 60Hz	480V 3 wire 60Hz
Output				
Size	49 x 54 x 47H	56 x 40 x 80H	44 x 63 x 70H	44 x 63 x 70H
Weight	(0.96 ft ³ /kVA) 4325 lb	(1.38 ft ³ /kVA) 3200 lb	(4.49 ft ³ /kVA) 3400 lb	(3.59 ft ³ /kVA) 3500 lb
Voltage Reg	(57.7 1b/kVA) 0.5%	(42.7 1b/kVA) 0.5%	(136 1b/kVA) 0.5%	(112 1b/kVA) 0.5%
Frequency Regulation	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency
Harmonic Distortion	1.0% (output)	1.5% (output)	1.5% (output)	1.5% (output)
Environment	-40°C to 52°C 0% to 100%RH 0 to 10,000 ft elevation Outdoor enclosure	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation

FREQUENCY CHANGERS
 $15 < P \leq 60\text{kW}$

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model	RVG 65-030 (MG Set)	RVG 65-040 (MG Set)	RVG 65-060 (MG Set)	RVG 64-020 (MG Set)
Rating	30kW, 37.5kVA	40kW, 50kW	60kW, 75kVA	20kW, 25kVA
Input	480v 3 wire 60Hz	480v 3 wire 60Hz	480v 3 wire 60Hz	480v 3 wire 60Hz
Output				
	200v 4 wire 400Hz	200v 4 wire 400Hz	200v 4 wire 400Hz	200v 4 wire 400Hz
Size	44 x 63 x 70H (2.99 ft ³ /kVA)	50 x 75 x 70H (3.04 ft ³ /kVA)	50 x 75 x 70H (2.03 ft ³ /kVA)	56 x 40 x 80H (4.15 ft ³ /kVA)
Weight	3750 lb (100 lb/kVA)	4000 lb (80 lb/kVA)	5000 lb (66.7 lb/kVA)	3700 lb (148 lb/kVA)
Voltage Reg	0.5%	0.5%	0.5%	0.5%
Frequency Regulation	Synchronous with input frequency			
Harmonic Distortion	1.5% (output)	1.5% (output)	1.5% (output)	1.5% (output)
Environment	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation

FREQUENCY CHANGERS
 $15 < P \leq 60\text{kW}$

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Unitron
Model	RVG 64-030 (MG Set)	RVG 64-040 (MG Set)	RVG 64-060 (MG Set)	GPC-40
Rating	30kW, 37.5kVA	40kW, 50kVA	60kW, 75kVA	40.0kVA
Input	480v 3 wire 60Hz	480v 3 wire 60Hz	480v 3 wire 60Hz	460v, 50/60Hz
Output				
Size	56 x 40 x 80H (2.8 ft ³ /kVA)	56 x 40 x 80H (2.1 ft ³ /kVA)	56 x 40 x 80H (1.4 ft ³ /kVA)	12 x 41 x 42H (0.3 ft ³ /kVA)
Weight	3800 lb	3900 lb	4100 lb	500 lb
Voltage Reg	(101 lb/kVA) 0.5%	(78 lb/kVA) 0.5%	(55 lb/kVA) 0.5%	(12 lb/kVA) 120/208 $\pm 0.5\%$
Frequency Regulation	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency	
Harmonic Distortion	1.5% (output)	1.5% (output)	1.5% (output)	2% (output)
Environment	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation	0 to 50°C 10% to 95%RH 0 to 3,300 ft elevation	Environmentally secure

FREQUENCY CHANGERS
 $15 < P \leq 60\text{kW}$

Table 5. (Continued).

Company	Varo	Varo	Nova Electric
Model	44—	44—	FC20K3/X
Rating	16kW	25kW	20kVA
Input	440v, 3 phase 3 wire 60Hz	440v, 3 phase 3 wire 60Hz	440v, 3 phase 3 wire 60Hz
Output	450v, 3 phase 3 wire 400Hz	450v, 3 phase 3 wire 400Hz	450v, 3 phase 3 wire 400Hz
Size			120 or 208VAC, 3 phase 50 or 60 or 400Hz
Weight			30 x 44 x 64H (2.44 ft ³ /kVA)
Voltage Reg	18	18	1500 lb (75 lb/kVA)
Frequency Regulation			18
Harmonic Distortion	2.5% (output)	2.5% (output)	0.15%
Environment			48
			-20 to 50°C

X denotes output frequency

FREQUENCY CHANGERS
15 < P \leq 60kW

Table 5. (Continued).

Company	CTS of Canada	Kurz & Root Company	Kurz & Root Company	Kurz & Root Company
Model	MC 1A (MG Set)	MD3 (MG Set)	MD4 (MG Set)	MD4 (MG Set)
Rating	30kW	30kW	60kW	60kW
Input	120 or 208 or 600VAC, 50 or 60Hz	220 or 440VAC, 3 phase, 60Hz	220 or 440VAC, 3 phase, 60Hz	220 or 440VAC, 3 phase, 60Hz
Output	Various 3 phase, 50 or 60 or 400Hz	120 or 208VAC, 3 phase, 400Hz	120 or 208VAC, 3 phase, 400Hz	120 or 208VAC, 3 phase, 400Hz
Size	108 x 50 1/2 x 40H	65 x 41 x 36 1/2H	72 1/2 x 36 1/4 x 41H	72 1/2 x 36 1/4 x 41H
Weight	(4.21 ft ³ /kVA) 4100 lb	(1.88 ft ³ /kVA) 2650 lb	(1.04 ft ³ /kVA) 3680 lb	(1.04 ft ³ /kVA) 3680 lb
Voltage Reg	2%			
Frequency Regulation	0.01%			
Harmonic Distortion	3 to 5%			
Environment	32 to 132°F 95%RH 10,000 ft	-40 to 55°C	-40 to 55°C	-40 to 55°C

FREQUENCY CHANGER
15 < P < 60kW

Table 5. (Continued).

Company	Bendix Corp	Brown Boveri Cie	Brown Boveri Cie
Model	38B67-2	TK 22053	TKR 33053
Rating	20 kVA	22kVA	33kVA
Input	400 to 550 VAC 3 phase, 400 Hz	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz
Output			
Size	120 VAC, 1 phase, 60 Hz 450 VAC, 3 phase, 60 Hz 23.4 x 20.8 x 25.2H	35 to 380VAC, 3 phase 5 to 87Hz 375 x 440 x 870H mm	35 to 380VAC, 3 phase 5 to 87Hz 375 x 440 x 870H mm
Weight	(0.355 ft ³ /kVA) 418 lb	(0.23 ft ³ /kVA) 60 kg	(0.154 ft ³ /kVA) 60 kg
Voltage Reg	(20.9 lb/kVA) 3%	(6.01 lb/kVA)	(4.01 lb/kVA)
Frequency Regulation	3%		
Harmonic Distortion			
Environment			-10 to 40°C
			-10 to 40°C

FREQUENCY CHANGERS
 $60\text{kw} < P \leq$

Table 5. (Continued).

Company	ABEK-JETWAY	ABEK-JETWAY	Franklin Electric	CTS of Canada
Model	90	120	4125	8350
Rating	90kVA	120kVA	125kVA	125kVA
Input	230-600VAC 30, 50-60Hz	230-600VAC 30, 50-60Hz	208 or 380 or 480VAC 50 or 60Hz	120 or 208 or 600VAC 50 or 60Hz
Output				
Size	64 x 54 x 16H 30, 400Hz	115/200VAC 30, 400Hz	208VAC, 3 phase 400 or 415 or 441Hz	Various 3 phase 50 or 60 or 400Hz
Weight	(0.356 ft ³ /kVA) 1800 lb	64 x 54 x 16H (0.267 ft ³ /kVA) 2100 lb	36 x 72 x 72H (0.864 ft ³ /kVA) 5000 lb	
Voltage Reg	(20 1b/kVA) $\pm 3\%$	(17.5 1b/kVA) $\pm 3\%$	(40 1b/kVA) 1%	2%
Frequency Regulation	$\pm .04\%$	$\pm .04\%$	0.5%	0.01%
Harmonic Distortion	5%	5%	5%	3 to 5%
Environment				
	-40 to +55°C, 90% HC 5000 ft outdoor encl	-40 to +55°C, 90% HC 5000 ft outdoor encl	32 to 104°F 95%RH 3300 ft	32 to 132°F 95%RH 10,000 ft

FREQUENCY CHANGERS
 $60\text{kW} < P \leq$

Table 5. (Continued).

Company	A.L.S. Electronics	Bogue	Bogue
Model	75kVA FCT	100kVA FCT	
Rating	75kVA (\$20900 (\$0.28/VA)	(rotating transformer) \$2100 (\$0.72/VA)	8109 (MG Set)
Input	375kVA	75kVA	100kW, 125kVA
Output	440v, 60Hz	380v, 3 phase, 50Hz	380v, 3 phase, 50Hz
Size	440v, 400Hz	480v, 3 phase, 60Hz	480v, 3 phase, 60Hz
Weight	39 1/4 x 28 x 67H (0.568 ft ³ /kVA)	39 1/4 x 28 x 67H (0.426 ft ³ /kVA)	3200 lb
Voltage Reg	1.063%	(40 lb/kVA)	(32 lb/kVA)
Frequency Regulation	0.5%		1%
Harmonic Distortion	3% (output)		2% (output)
Environment			

FREQUENCY CHANGER
 $60\text{kW} < P \leq$

Table 5. (Continued).

Company	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie
Model	BBK 09531	BBK 14021	LWA 099	LWA 199
Rating	95kVA	140kVA	99kW	199kW
Input	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz	380 or 415 or 500VAC 3 phase, 50 or 60Hz	380 or 415 or 500VAC 3 phase, 50 or 60Hz
Output	30 to 360VAC, 3 phase 5 to 150Hz	30 to 360VAC, 3 phase 5 to 87Hz	38-380 or 50-500VAC 3 phase, 5-50Hz	38-380 or 50-500VAC 3 phase, 5-50Hz
Size	600 x 600 x 2200H mm	600 x 800 x 2200H mm	600 x 1000 x 2200H mm	600 x 1000 x 2200H mm
	(0.294 ft ³ /kVA)	(0.266 ft ³ /kVA)	(0.471 ft ³ /kVA)	(0.234 ft ³ /kVA)
Weight	460 kg	550 kg		
	(10.7 lb/kVA)	(8.66 lb/kVA)		
Voltage Reg				
Frequency Regulation				
Harmonic Distortion				
Environment				
	-10 to 35°C	-10 to 35°C	-10 to 45°C	-10 to 45°C
			1000 m	1000 m

FREQUENCY CHANGER
 $60\text{kW} < P \leq$

Table 5. (Continued).

Company	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie
Model	SNK 20034	SNK 28034	SNK 38034	SNK 54034
Rating	200kVA	280kVA	380kVA	540kVA
Input	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz
Output				
Size	800 x 800 x 2200H mm (0.249 ft ³ /kVA)	10 to 500VAC, 3 phase 5 to 150Hz 800 x 800 x 2200H mm (0.178 ft ³ /kVA)	10 to 500VAC, 3 phase 5 to 150Hz 800 x 1600 x 2200H mm (0.262 ft ³ /kVA)	10 to 500VAC, 3 phase 5 to 150Hz 800 x 1600 x 2200H mm (0.184 ft ³ /kVA)
Weight				
Voltage Reg				
Frequency Regulation				
Harmonic Distortion				
Environment				
	-10 to 35°C	-10 to 35°C	-10 to 35°C	-10 to 35°C
				-10 to 35°C

FREQUENCY CHANGER
 $60\text{kW} < P \leq$

Table 5. (Continued).

Company	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie
Model				
LWA 144	LWA 180	LWA 225	LWA 283	
Rating				
Input	144kVA	180kVA	225kVA	283kVA
Output	380 or 415 or 500VAC 3 phase, 50 or 60Hz	380 or 415 or 500VAC 3 phase, 50 or 60Hz	380 or 415 or 500VAC 3 phase, 50 or 60Hz	380 or 415 or 500VAC 3 phase, 50 or 60Hz
Size	38-380 or 50-500VAC 3 phase, 5-50Hz			
Weight	600 x 1000 x 2200H mm (0.324 ft ³ /kVA)	600 x 1000 x 2200H mm (0.259 ft ³ /kVA)	600 x 1000 x 2200H mm (0.207 ft ³ /kVA)	600 x 1000 x 2200H mm (0.165 ft ³ /kVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion				
Environment				
	-10 to 45°C 1000 m			

FREQUENCY CHANGER
60kW < P \leq

Table 5. (Continued).

Company	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie
Model	SNK 06531	SNK 12031	SNK 17031	SNK 25031
Rating	65kVA	120kVA	170kVA	250kVA
Input	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz
Output				
	7.5 to 380VAC, 3 phase 5 to 150Hz	7.5 to 380VAC, 3 phase 5 to 150Hz	7.5 to 380VAC, 3 phase 5 to 150Hz	7.5 to 380VAC, 3 phase 5 to 150Hz
Size	600 x 600 x 2200H mm (0.43 ft ³ /kVA)	600 x 600 x 2200H mm (0.233 ft ³ /kVA)	800 x 800 x 2200H mm (0.292 ft ³ /kVA)	800 x 800 x 2200H mm (0.199 ft ³ /kVA)
Weight				
Voltage Reg				
Frequency Regulation				
Harmonic Distortion				
Environment				
	-10 to 35°C	-10 to 35°C	-10 to 35°C	-10 to 35°C
				-10 to 35°C

FREQUENCY CHANGER
 $60\text{kW} < P \leq$

Table 5. (Continued).

Company	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie	Brown Boveri Cie
Model	SNK 32031	SNK 45031	SNK 08034	SNK 14534
Rating				
Input	320kVA	450kVA	80kVA	145kVA
Output	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz	380VAC, 3 phase 50 or 60Hz
Size	7.5 to 380VAC, 3 phase 5 to 150Hz	7.5 to 380VAC, 3 phase 5 to 150Hz	10 to 500VAC, 3 phase 5 to 150Hz	10 to 500VAC, 3 phase 5 to 150Hz
Weight	800 x 1600 x 2200H mm (0.311 ft ³ /kVA)	800 x 1600 x 2200H mm (0.221 ft ³ /kVA)	600 x 600 x 2200H mm (0.35 ft ³ /kVA)	600 x 600 x 2200H mm (0.193 ft ³ /kVA)
Voltage Reg				
Frequency Regulation				
Harmonic Distortion				
Environment				
	-10 to 35°C	-10 to 35°C	-10 to 35°C	-10 to 35°C
				-10 to 35°C

FREQUENCY CHANGERS
 $60\text{kW} < P \leq$

Table 5. (Continued).

Company	Boque	Teledyne Inet A/C 63	Teledyne Inet A/C 72	Teledyne Inet A/C 110
Model	7383	\$18500 (\$2.64/kVA)	\$18900 (\$2.36/kVA)	\$20300 (\$1.66/kVA)
Rating	200kW	63kW, 70kVA	72kW, 80kVA	110kW, 122kVA
Input				
Output	460v, 3 phase, 60Hz	440v, 3 wire, 60Hz	440v, 3 wire, 60Hz	440v, 3 wire, 60Hz
Size	120/208v, 3 phase, 400Hz	450v, 3 wire, 400Hz	450v, 3 wire, 400Hz	450v, 3 wire, 400Hz
Weight		72 x 29 x 75H (1.3 ft ³ /kVA) 5500 lb	72 x 29 x 75H (1.1 ft ³ /kVA) 5500 lb	72 x 29 x 75H (0.75 ft ³ /kVA) 5500 lb
Voltage Reg		(78 1b/kVA) ±0.3%	(69 1b/kVA) ±0.3%	(45 1b/kVA) ±0.3%
Frequency Regulation		±0.025%	±0.025%	±0.025%
Harmonic Distortion		2% (output) 3% (input)	2% (output) 3% (input)	2% (output) 3% (input)
Environment		0 to 50°C, 100%RH 0 to 8000 ft drip-proof	0 to 50°C, 100%RH 0 to 8000 ft drip-proof	0 to 50°C, 100%RH 8000 ft drip-proof

FREQUENCY CHANGERS
 $60\text{kW} < P \leq$

Table 5. (Continued).

Company	Teledyne Inet A/C 160	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model	\$21900 (\$1.23/kVA)	RHG 64-075 (MG Set)	RHG 64-100 (MG Set)	RHG 64-125 (MG Set)
Rating	160kW, 178kVA	75kW, 93.7kVA	100kW, 125kVA	125kW, 156kVA
Input				
Output	440v, 3 wire, 60Hz	480v, 3 wire, 60Hz	480v, 3 wire, 60Hz	480v, 3 wire, 60Hz
Size	72 x 29 x 75H (0.51 ft ³ /kVA)	53 x 50 x 70H (1.15 ft ³ /kVA)	53 x 50 x 70H (4.29 ft ³ /kVA)	53 x 50 x 70H (0.688 ft ³ /kVA)
Weight	5900 lb (33.1 lb/kVA)	4200 lb (44.8 lb/kVA)	4200 lb (33.6 lb/kVA)	4400 lb (28.2 lb/kVA)
Voltage Reg	$\pm 0.3\%$	0.5%	0.5%	0.5%
Frequency Regulation	$\pm 0.025\%$	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency
Harmonic Distortion	2% (output) 3% (input)	1.5% (output)	1.5% (output)	1.5% (output)
Environment	0 to 50°C, 100%RH 8000 ft drip-proof	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft

FREQUENCY CHANGERS
60kW < P <

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model	RIG 65-075 (MG Set)	RIG 65-100 (MG Set)	RIG 65-125 (MG Set)	RIG 65-150 (MG Set)
Rating	75kW, 93.75kVA	100kW, 125kVA	125kW, 156kVA	150kW, 188kVA
Input	480v, 3 wire, 60Hz			
Output				
Size	50 x 100 x 72H (2.2 ft ³ /kVA)	62 x 194 x 78H (4.3 ft ³ /kVA)	62 x 194 x 78H (3.48 ft ³ /kVA)	62 x 149 x 78H (2.22 ft ³ /kVA)
Weight	5500 lb (59 lb/kVA)	10000 lb (80 lb/kVA)	10100 lb (65 lb/kVA)	10250 lb (55 lb/kVA)
Voltage Reg	0.5%	0.5%	0.5%	0.5%
Frequency Regulation	Synchronous with input frequency			
Harmonic Distortion	1.5% (output)	1.5% (output)	1.5% (output)	1.5% (output)
Environment	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft

FREQUENCY CHANGERS
60kW < P <

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model	RHG 65-150 (MG Set)	RHG 65-200 (MG Set)	RHG 65-250 (MG Set)	RHG 65-300 (MG Set)
Rating	150kW, 188kVA	200kW, 250kVA	250kW, 312.5kVA	300kW, 375kVA
Input	480v, 3 wire, 60Hz			
Output				
Size	62 x 149 x 78H (2.22 ft ³ /kVA)	62 x 149 x 78H (1.67 ft ³ /kVA)	62 x 149 x 78H (1.33 ft ³ /kVA)	62 x 149 x 78H (1.11 ft ³ /kVA)
Weight	10250 lb	10250 lb	10750 lb	11000 lb
Voltage Reg	0.5%	0.5%	0.5%	0.5%
Frequency Regulation	Synchronous with input frequency			
Harmonic Distortion	1.5% (output)	1.5% (output)	1.5% (output)	1.5% (output)
Environment	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft

FREQUENCY CHANGERS
60kW < P <

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model	RVD 64-067 (MG Set)	RVG 64-075 (MG Set)	RVG 64-100 (MG Set)	RVG 64-125 (MG Set)
Rating	76.5kW, 75kVA	75kW, 93.75kVA	100kW, 125kVA	125kW, 156kVA
Input	480v, 3 wire, 60Hz			
Output	250v, 4 wire, 400Hz	200v, 4 wire, 400Hz	160v, 4 wire, 400Hz	200v, 4 wire, 400Hz
Size	56 x 40 x 80H			
	(±38 ft ³ /kVA)	(1.11 ft ³ /kVA)	(0.85 ft ³ /kVA)	(0.66 ft ³ /kVA)
Weight	4150 lb	4250 lb	4500 lb	4750 lb
	(55.3 lb/kVA)	(45.3 lb/kVA)	(36.1 lb/kVA)	(30.4 lb/kVA)
Voltage Reg	0.5%	0.5%	0.5%	0.5%
Frequency Regulation	Synchronous with input frequency			
Harmonic Distortion	1.5% (output)	1.5% (output)	1.5% (output)	1.5% (output)
Environment	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft

FREQUENCY CHANGERS
 $60\text{ kVA} < P <$

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model	RVG 64-150 (MG Set)	RVG 64-160 (MG Set)	RVG 64-200 (MG Set)	RVG 64-250 (MG Set)
Rating	150kW, 188kVA	160kW, 200kVA	200kW, 250kVA	250kW, 312.75kVA
Input	480v, 3 wire, 60Hz			
Output				
Size	250v, 4 wire, 400Hz 56 x 40 x 80H	200v, 4 wire, 400Hz 56 x 40 x 80H	200v, 4 wire, 400Hz 56 x 40 x 80H	200v, 4 wire, 400Hz 56 x 40 x 80H
Weight	(0.55 ft ³ /kVA) 4900 lb	(0.52 ft ³ /kVA) 5850 lb	(0.41 ft ³ /kVA) 6700 lb	(0.33 ft ³ /kVA) 7000 lb
Voltage Reg	(26.1 lb/kVA) 0.5%	(29.3 lb/kVA) 0.5%	(26.8 lb/kVA) 0.5%	(22.4 lb/kVA) 0.5%
Frequency Regulation	Synchronous with input frequency			
Harmonic Distortion	1.5% (output)	1.5% (output)	1.5% (output)	1.5% (output)
Environment	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft

FREQUENCY CHANGERS
60kW < P <

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model	RHG 66-125 (MG Set)	RHG 66-150 (MG Set)	RHG 66-160 (MG Set)	RVG 66-075 (MG Set)
Rating	125kW, 156kVA	150kW, 188kVA	160kW, 200kVA	75kW, 93.75kVA
Input				
Output	480v, 3 wire, 60 Hz			
Size	200v, 4 wire, 400 Hz 53 x 51 x 70H	200v, 4 wire, 400 Hz 53 x 51 x 70H	200v, 4 wire, 400 Hz 53 x 51 x 70H	200v, 4 wire, 400 Hz 56 x 40 x 80H
Weight	(0.7 ft ³ /kVA) 4200 lb	(0.58 ft ³ /kVA) 4400 lb	(0.55 ft ³ /kVA) 4400 lb	(1.11 ft ³ /kVA) 3350 lb
Voltage Reg	(26.9 lb/kVA) 0.5%	(23.4 lb/kVA) 0.5%	(22.1b/kVA) 0.5%	(35.7 lb/kVA) 0.5%
Frequency Regulation	Synchronous with input frequency			
Harmonic Distortion	1.5% (output)	1.5% (output)	1.5% (output)	1.5% (output)
Environment	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft

FREQUENCY CHANGERS
 60kW < P <

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model	RVG 66-100 (MG Set)	RVG 66-125 (MG Set)	RVG 66-150 (MG Set)	RVG 66-175 (MG Set)
Rating	100kW, 125kVA	125kW, 156kVA	150kW, 180kVA	175kW, 218.75kVA
Input				
Output	480v, 3 wire, 60 Hz			
Size	56 x 40 x 80H (0.83 ft ³ /kVA)	56 x 40 x 80H (0.66 ft ³ /kVA)	56 x 40 x 80H (0.58 ft ³ /kVA)	56 x 40 x 80H (0.47 ft ³ /kVA)
Weight	3600 lb	3850 lb	4000 lb	5500 lb
Voltage Reg	(28.8 lb/kVA) 0.5%	(24.7 lb/kVA) 0.5%	(22.2 lb/kVA) 0.5%	(25.1 lb/kVA) 0.5%
Frequency Regulation	Synchronous with input frequency			
Harmonic Distortion	1.5% (output)	1.5% (output)	1.5% (output)	1.5% (output)
Environment	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft

FREQUENCY CHANGERS
60kW < P <

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model	RVG 66-200 (MG Set)	RVG 66-250 (MG Set)	RVG 66-300 (MG Set)	RVM 64-250 (MG Set)
Rating	200kW, 250kVA	250kW, 312.5kVA	300kW, 375kVA	250kW, 312.5kVA
Input	480v, 3 wire, 60 Hz			
Output	200v, 4 wire, 400 Hz			
Size	56 x 40 x 80H (0.41 ft ³ /kVA)	56 x 40 x 80H (0.33 ft ³ /kVA)	56 x 40 x 80H (0.28 ft ³ /kVA)	59 x 87 x 87H (0.83 ft ³ /kVA)
Weight	5800 lb	6100 lb	6450 lb	8850 lb
Voltage Reg	0.5%	0.5%	0.5%	1.0%
Frequency Regulation	Synchronous with input frequency			
Harmonic Distortion	1.5% (output)	1.5% (output)	1.5% (output)	1.5% (output)
Environment	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft Outdoor Enclosure

FREQUENCY CHANGERS
 $60\text{kw} < P <$

Table 5. (Continued).

Company	Varo	Varo	Franklin Electric
Model	4412	44—	475
Rating	63kw	100kw	160kw
Input			75kVA
Output	440v, 30, 3 wire, 60 Hz	440v, 30, 3 wire, 60 Hz	208 or 380 or 480VAC 50 or 60Hz
Size	450, 30, 3 wire, 400 Hz	450, 30, 3 wire, 400 Hz	208VAC, 3 phase 400 or 415 or 441Hz 36 x 54 x 72H
Weight			(1.08 ft ³ /kVA) 3800 lb
Voltage Reg	18	18	(50.7 lb/kVA) 18
Frequency Regulation			0.5%
Harmonic Distortion	2.5% (output)	2.5% (output)	5%
Environment			32 to 104°F 95%RH 3300 ft

FREQUENCY CHANGERS
60kW < P <

Table 5. (Continued).

Company	Teledyne Inet	Teledyne Inet	Teledyne Inet
Model	RVG 64-250 (MG Set)	RVG 66-075 (MG Set)	RVG 66-100 (MG Set)
Rating	250kW, 312.5kVA	75kW, 93.75kVA	100kW, 125kVA
Input			
	480v, 3 wire, 60Hz	480v, 3 wire, 60Hz	480v, 3 wire, 60Hz
Output			
	250v, 4 wire, 400Hz	200v, 4 wire, 400Hz	200v, 4 wire, 400Hz
Size	56 x 40 x 80H (0.33 ft ³ /kVA)	45 x 47 x 68H (0.89 ft ³ /kVA)	53 x 51 x 70H (0.88 ft ³ /kVA)
Weight	7000 lb (22.4 lb/kVA)	2800 lb (29.9 lb/kVA)	4200 lb (33.6 lb/kVA)
Voltage Reg	0.5%	0.5%	0.5%
Frequency Regulation	Synchronous with input frequency	Synchronous with input frequency	Synchronous with input frequency
Harmonic Distortion	1.5% (output)	1.5% (output)	1.5% (output)
Environment	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft	0°C to 50°C 10% to 95% Humidity Elevation 0 ft to 3300ft

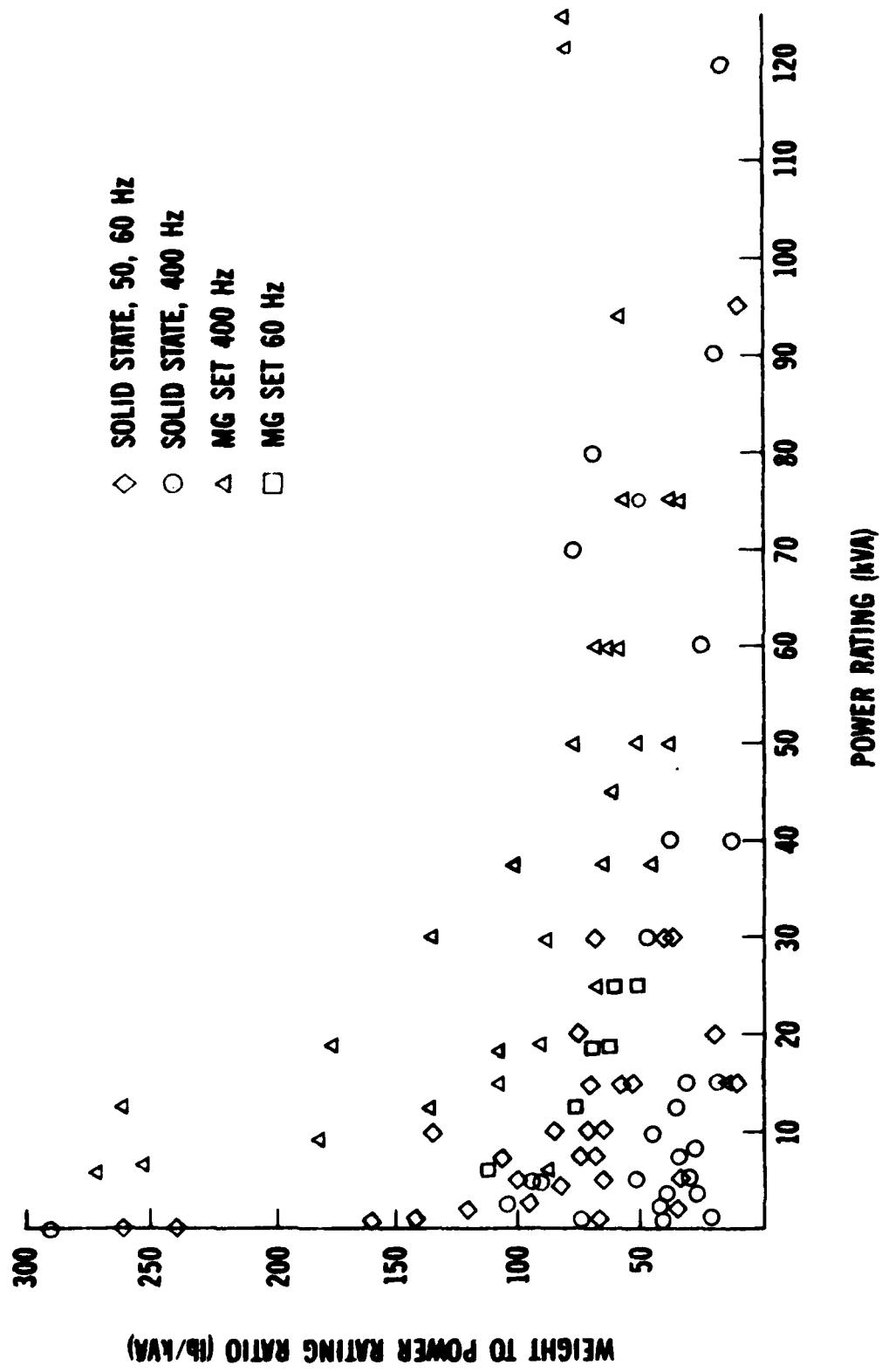


Figure 3. Weight to power rating ratio of frequency changers vs power rating.

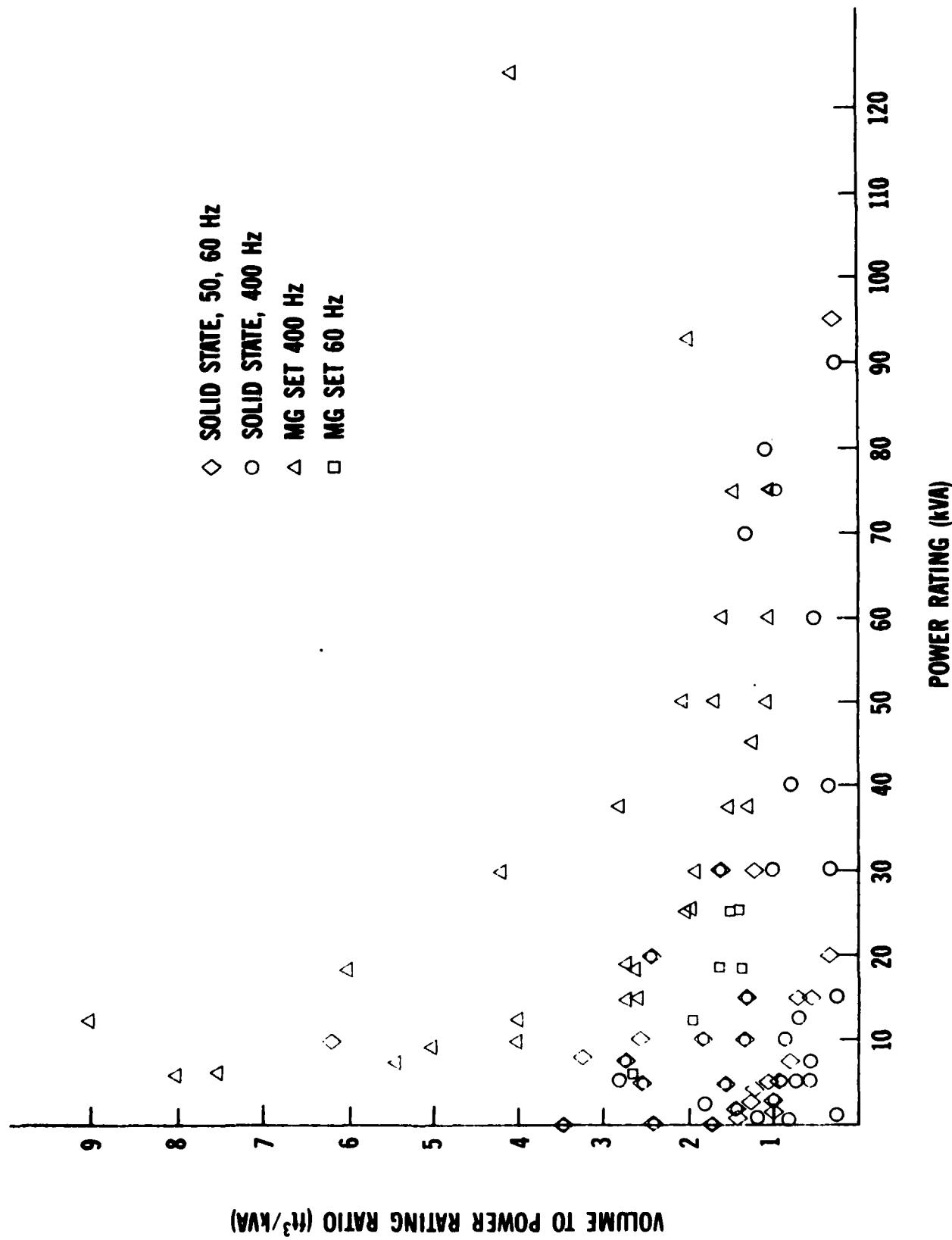


Figure 4. Volume to power rating ratio for frequency changers vs power rating.

In the power range from 5 kW to 15 kW, one unit from A.L.S. Corp. (Model SMG-15M) is built to military specifications with an operating temperature range of -34 to +53° C. Voltage and frequency regulation are within the precise specification of MIL-STD 1332. Input frequency range is 45 Hz to 65 Hz with an output at 400 Hz. Weight to power ratio is 55 lb/kVA. Powertronic Systems has a unit at 15 kVA with weight to power ratio of 10 lb/kVA, somewhat lower than average at that power level. According to Powertronic Systems, this unit is not marketed at present. The same comments as before apply to California Instruments models.

In the 15 kW to 60 kW power range, none of the units stand out. The A.L.S. models meet the voltage and frequency regulation requirement for MIL-STD 1332, but the operating temperature range is 0 to 40° C. Weight to power ratios are about 15 lb/kVA for 400 Hz units and about 40 lb/kVA for 60 Hz units. The Teledyne Inet MG sets which have operating temperature ranges extending to about -40° C (MMG IA and MD4) are limited to having output frequency regulation synchronous with the input. Nova Electric has models such as FC20K3/X which allow a range of input frequencies.

In the power range greater than 60 kW, Teledyne Inet has some solid state units intended for shipboard power (AC68 thru 160). However, Teledyne states that these models are not adaptable to field use in rough terrain.

Although more flexible than other units, these units which allow a range of input frequencies are not general purpose, since multiple input voltages are not similarly available on the same units.

VI. COST INFORMATION

Only a limited amount of cost information was obtained through this survey. Where available, the cost (and cost/VA) is shown with the model designation on the data sheets. These data are displayed in the form of cost per VA versus rating in Figure 5. There is a range of approximately \$2.00/VA to \$4.25/VA in the low (<5) kVA ratings. The range tends to narrow at higher ratings and the trend, as expected, is to lower cost per VA at higher ratings (\$1.00/VA at 60 kVA). The spread is due to a number of factors including technology type, production methods, and sales, which are difficult to separate or define based on the available data.

The data are displayed in the form of cost/pound vs rating in Figure 6. At the low kVA ratings the scatter is quite large, and it is difficult to draw any conclusion. At ratings above 10 kVA the scatter is smaller, and the values are in the range of \$10/lb to \$15/lb.

Even fewer data were provided for unit cost vs quantity purchased. Those data available are plotted in Figure 7 (see, also, Table 6). Unit price has been normalized to unity at 500 units. The ordinate, then, is the relative unit cost and the abscissa is the number of units purchased. These data show that a change in the range of 9 percent to 23 percent in unit price can be expected when the purchased quantity changes from 50 units to 500 units. For two families (the upper curves), the data indicate a change of about 38 percent in unit price between 50 units and 500 units. (The smooth curves are drawn to guide the eye of the viewer; they do not represent a functional fit to the data.)

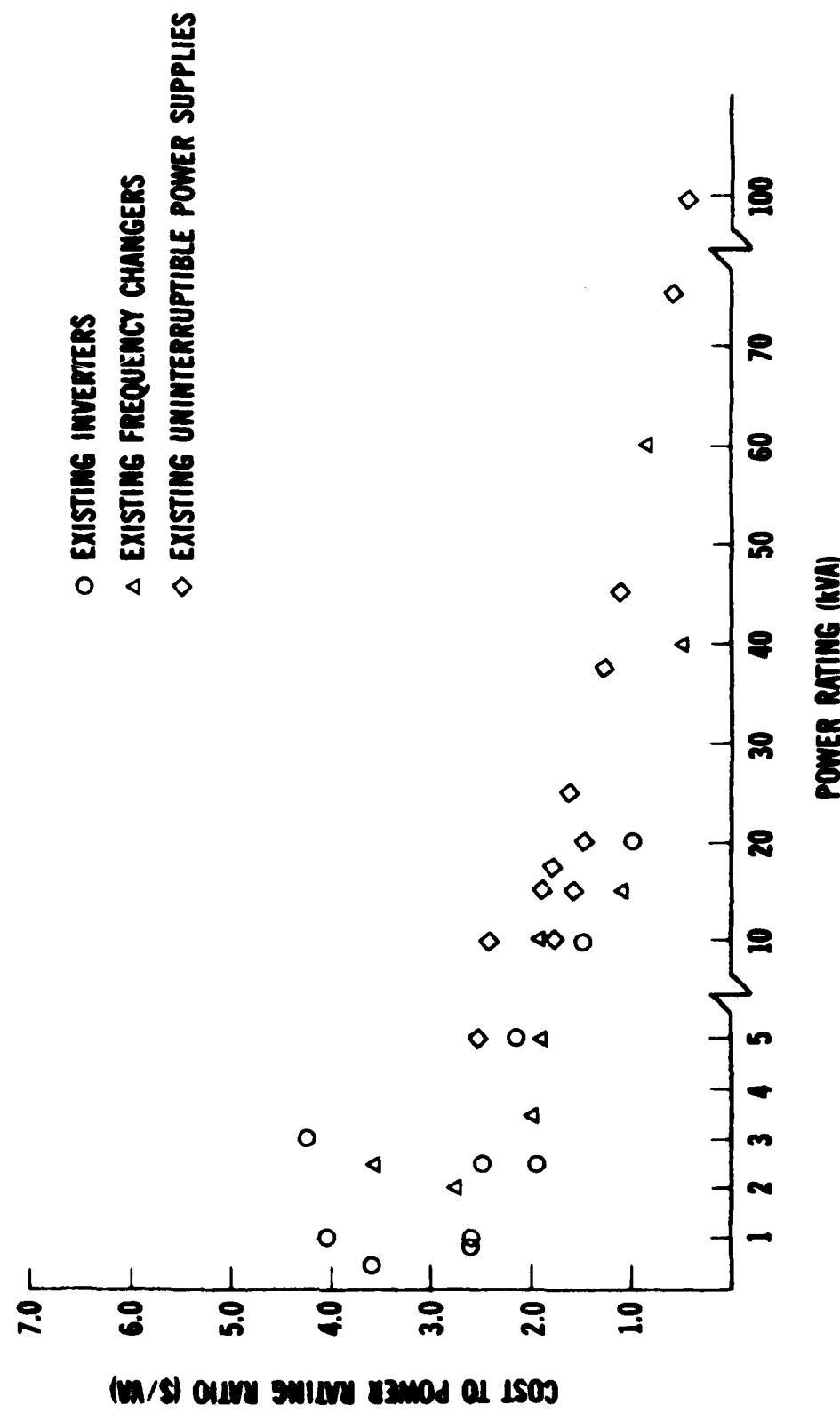


Figure 5. Cost to power rating ratio vs power rating.

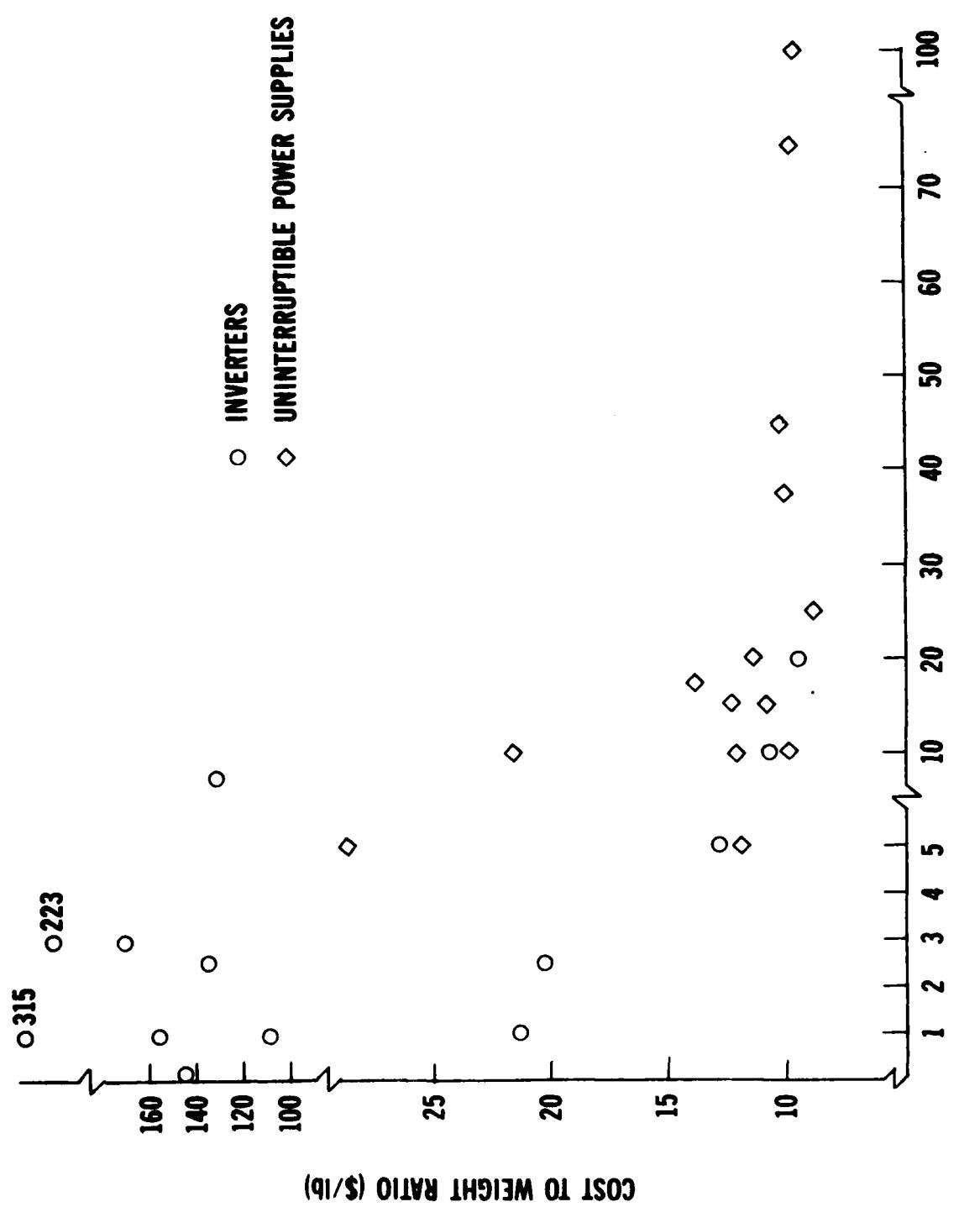


Figure 6. Cost to weight ratio vs power rating.

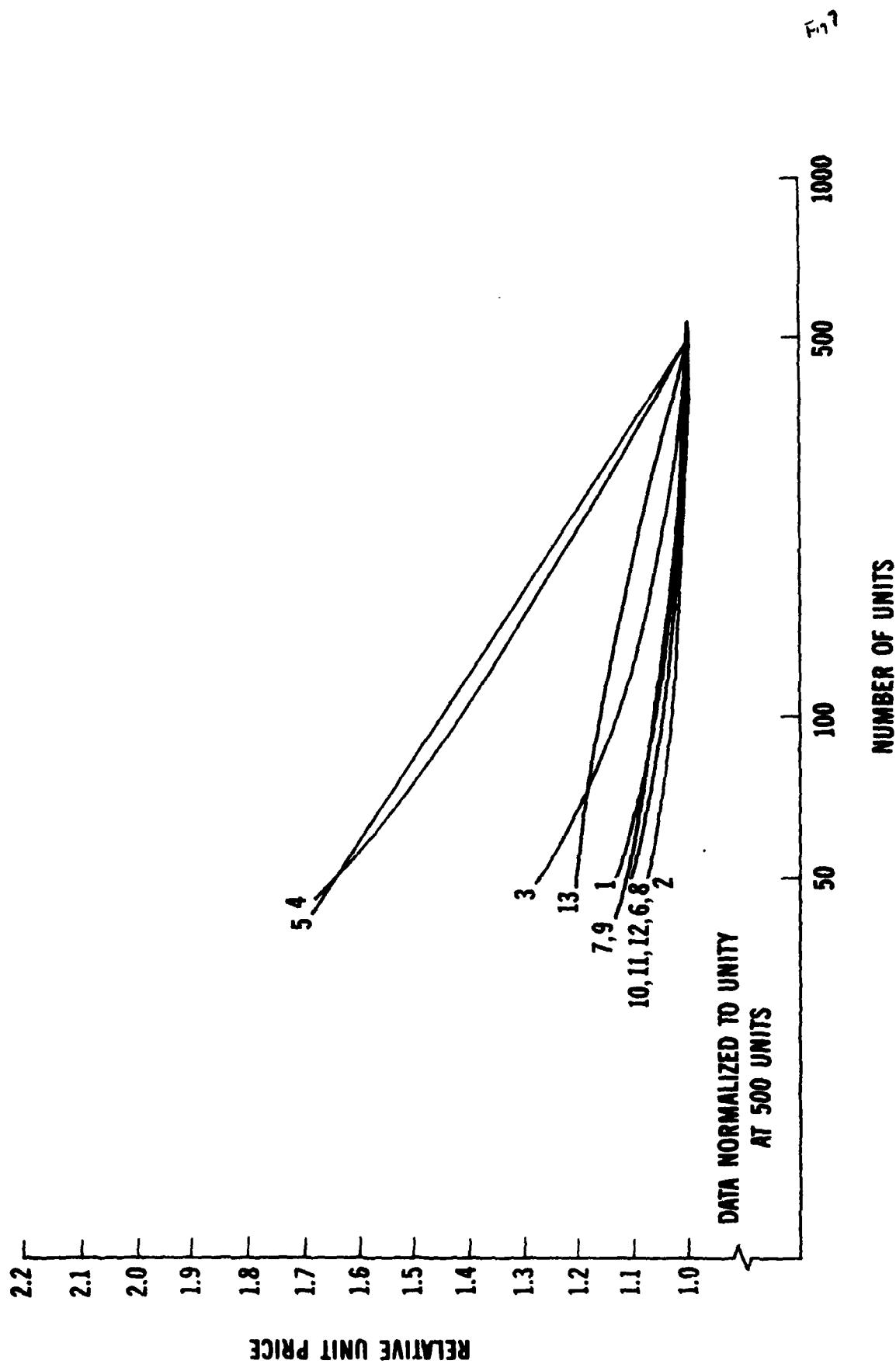


Figure 7. Relative unit price vs quantity procured.

Table 6. Key to Data in Figure 7.

Curve	Manufacturer	Model
1	UNITRON	CR-074-3
2	UNITRON	CR-154-3
3	UNITRON	GFC-40
4	UNITRON	PS-69-359
5	UNITRON	PS-62-66D
6	TELEDYNE	A/C 63
7	TELEDYNE	A/C 72
8	TELEDYNE	A/C 110
9	TELEDYNE	A/C 160
10	TELEDYNE	Series 75
11	TELEDYNE	Series 100
12	TELEDYNE	Series 125
13	WESTINGHOUSE	AVI-623

VII. CONCLUSIONS

- This survey has not located any general purpose (multi-frequency, multi-voltage, transportable, environmentally protected) power conditioners.
- Essentially all systems are single-frequency in, single-frequency out; all combinations of standard (50-Hz, 60-Hz, 400-Hz) frequencies seem to be supported.
- Most units allow only limited or no input and output voltage reconnection. Many units provide a choice of standard connections on order.
- With the exception of aircraft inverter technology, little emphasis has been given to size and weight constraints.
- Few units are designed for operation over the military temperature and altitude range.
- The categories of frequency chargers and uninterruptible power supplies are fairly well represented across the power ratings from 1-1/2 kW to 200 kW. The categories of inverters and converters are primarily represented in the lower power ranges.



APPENDIX A
DEPARTMENT OF THE ARMY
HEADQUARTERS UNITED STATES ARMY TRAINING AND DOCTRINE COMMAND
FORT MONROE VIRGINIA 23651

ATCD-MM

18 June 1980

SUBJECT: Letter of Agreement (LOA) for a Family of Military Electric Power Conditioners (PC)

SEE DISTRIBUTION

1. Reference AR 71-9.
2. Attached at inclosure 1 is the approved TRADOC/DARCOM Letter of Agreement for a Family of Military Electric Power Conditioners. The following information is applicable to this document:
 - a. System Designation: N/A.
 - b. Materiel Developer: DARCOM.
 - c. Combat Developer: USATRADOC.
 - d. User Representative: USATRADOC.
 - e. Trainer: USATRADOC.
 - f. Logistician: USALEA.
 - g. CARDS Reference Number: 0611A.
 - h. Operational Test Responsibility: USATRADOC.
 - i. USATRADOC Proponent Activity: USAES.
3. DARCOM, in coordination with the USATRADOC proponent activity, will initiate preparation of the Outline Development Plan (ODP) IAW AR 71-9.

ATCD-MM

18 June 1980

SUBJECT: Letter of Agreement (LOA) for a Family of Military Electric Power Conditioners (PC)

4. Subject requirement document is forwarded to major Army commands, other services and DoD agencies for harmonization and to all other addressees for information.

FOR THE COMMANDER:


ROBERT W. SANDER
LTC, GS
Asst AG

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as

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(See next page)

ATCD-MM

18 June 1980

SUBJECT: Letter of Agreement (LOA) for a Family of Military Electric
Power Conditioners (PC)

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SUPERINTENDENT

AHS, USA (AHS-COM)

USMA

TRADOC LO:

CINCUNC/USFK/EA SEOUL KOREA

CINCUSAREUR HEIDELBERG GERMANY (ATFE-LO-AE)

DARCOM

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TECOM

USMC DEV & EDUC COMD

USAF AIR WEA SVC (XRL)

DIRECTOR

NSA

MTMC (MTT-TRG)

LETTER OF AGREEMENT
FAMILY OF MILITARY ELECTRIC POWER CONDITIONERS (PC)

1. NEED:

a. The Army has a critical need in the 1985-1995 timeframe for a capability which will meet its increasing electrical power requirements and reduce the logistical burden associated with current approaches for conditioning the required energy. Increasing technical requirements including low acoustical and infrared (IER) signatures have been imposed on military power systems by the development of modern equipment such as computers, communications systems, target acquisition and fire control systems. Tactical power requirements for the Army require provision of such varied forms of power as: direct current (DC) and alternating current (AC) at 50/60 HERTZ (HZ), 400 HZ and 60 HZ only; single phase and three phase power; closely controlled frequency/voltage (precise power) from 28 volts DC to 460 volts AC; and uninterrupted power source (UPS) (no break power) in a range of power ratings from 1.5 kilowatts (KW) to 200 KW. Standardization efforts by the DOD Program Manager for Mobile Electric Power (PM-MEP) have reduced the types and numbers of generators for providing the required power to a minimum; however, some forms of power require costly special purpose generators. In order to provide both standard (utility) and precise power, the current system must use a utility and a precise power generator. The use of a family of power conditioners (PC) could significantly reduce, if not eliminate, the need for costly special purpose generators, thereby achieving substantial logistical savings. Power conditioners located with power consuming equipment could produce additional savings because the generator and/or distribution power ratings could be reduced through use of lower distribution frequencies or shorter distribution distances.

b. Catalog of approved requirements documents reference number:

2. OPERATIONAL CONCEPT:

a. The members of the family of electric power conditioners will be employed to condition power for tactical weapons systems in the field and for general purpose power requirements in semi-fixed locations. Employment with tactical weapons systems will require power equipment with small size, light weight and a high degree of mobility. Employment with systems in semi-fixed locations will require power equipment with increased operating life. Power conditioners can be used by all units having requirements for diverse forms of special purpose electric power in any area of the theater of operations. The family of electric power conditioners must be capable of specified performance at rated loads comparable to the special purpose generators which will be replaced. This family concept has been reviewed by the ABCA Standardization Program and other services.

b. Mission profile is attached as Annex A.

3. SYSTEM DESCRIPTION:

a. The family of electric power conditioners will consist of eight (8) solid state PC units in ratings between 1.5 KW and 200 KW to match the DOD standard family of Mobile Electric Power Sources (MEPS). Each individual power conditioner will be designed to be significantly smaller than the equivalent standard MEPS, e.g.: size - one to one hundred cubic feet, weight - 60 to 3,000 pounds, transportability - able to be transported by truck, trailer, helicopter or fixed wing aircraft as well as by, rail and marine craft. A separate operator will not be required after initial installation, except to change air filters.

b. Installation will insure that each PC unit will provide a suitable interface between an available power source and a load power requirement regardless of load or power source characteristics. The PC will be reconnectable in voltage and phase at both input and output; will provide for frequency conversion; and will be compatible with a no break or uninterrupted power source (UPS) requirement when connected to external storage batteries, fuel cells, commercial power or other auxiliary power sources to replace the prime power source. UPS is herein defined as the capability of providing steady-state power for a limited time within acceptable tolerance bands without damage to the power consuming equipment after prime power source failure occurs.

c. Reliability, availability and maintainability (RAM) is critical to the cost and operational effectiveness of the PC. Appropriate RAM requirements will be included in the PC Required Operational Capability (ROC).

d. Electronics Counter Measure/Counter-Countermeasures and Safety and Human Engineering considerations must be included in the design in accordance with applicable specifications.

e. Nuclear survivability is required and the system must be designed and constructed to survive the set of nuclear effects levels which will be stated in the outline acquisition plan and the key documents that lead up to this plan such as the Concept Formulation Package and the appropriate test plans.

f. To facilitate chemical agent decontamination, chemical agent resistant materials will be used to the maximum extent practicable in the development of this item.

g. This item will be painted with chemical agent resistant paints to facilitate chemical agent decontamination.

h. Personnel must be able to successfully perform their mission in

an NBC environment. This includes individual operations wherein personnel are clothed in their appropriate chemical/biological protective ensemble.

i. This family concept lends itself for other service or allied nation interest.

j. The system may be palletized, skid mounted or banded and will be transportable to and within the theater by highway, rail, marine and air transport. Suitable lifting and tie down devices will be provided as required.

k. All PCs must operate normally in climatic categories 1 through 6 without winterization kits.

l. All PCs must operate normally in climatic conditions 7 through 8 with winterization kits.

4. PROSPECTIVE OPERATIONAL EFFECTIVENESS AND COST:

a. The family of PCs should be able to reduce the logistics support necessary to provide electrical power in any tactical situation. This is done by reducing the need for low density special purpose generators and with the substitution of low cost tactical utility (TU) generators supplemented with PCs to meet diverse utility and precise power consuming needs required by weapons systems, maintenance shelters, or command posts. Employment of PCs in a tactical situation will reduce infrared (IR) or acoustical noise signatures over equivalently rated electrical generators, motor generator sets, rotary converters or inverters. In a peacetime situation where low acoustical noise is required, the PC can be used to convert commercial or foreign utility power sources to the proper voltage and frequency required probably at a lower cost over the use of tactical generators. These system capabilities can be achieved with no increase in crew size or logistic support requirements, probably at reduced cost relative to present systems.

b. Unit Flyaway Cost. Broad based estimates of unit flyaway cost expressed in constant FY78 dollars is \$1592 for the 1.5 KW PC, \$2684 for the 3 KW PC, \$3264 for the 5 KW PC, \$14,338 for the 10/15 KW PC, \$16,644 for the 30 KW PC, \$23,982 for the 60 KW PC, \$38107 for the 100 KW PC and \$60,514 for the 200 KW PC.

c. Manpower savings should result since there will be no increase in operator requirements and a potential decrease in annual maintenance man hours. Forecasted reduction in operator/maintenance man hours is envisioned by standardization of generators and an anticipated reduction in the inventory of special purpose generators.

5. SYSTEM DEVELOPMENT:

a. Operational Employment Plan: Commander, HQ TRADOC with input from HQ DARCOM will conduct the necessary studies, war games, test and evaluations to define the operational concepts. A system unique event that must be addressed by the combat developer and materiel developer is if the PC can provide military units with the conditioned power in required amounts and characteristics needed for mission accomplishment.

b. Technical Development Plan: The following system unique events will be addressed by the materiel developer:

(1) A study of frame sizes to determine whether the number of proposed ratings of the family of power conditioners can be changed or reduced to meet user needs.

(2) Establish whether the order of developments of individual ratings is optimal for maximum transfer of technology.

(3) The Combat and Materiel Developers will jointly develop RAM requirements for inclusion in the subsequent ROC or LR. Together they will develop a RAM Rational Annex that justifies and supports the quantitative RAM requirements. As a minimum, the RAM Rational Annex will contain the operational mode summary/mission profile, failure definition/scoring criteria, baseline analysis historical data, and definitions of RAM terms that are unique to this materiel.

(4) RAM will be a critical test issue for DTI and OTI.

c. Logistics Support Plan: The Combat and Materiel Developers will jointly conduct appropriate analysis and planning effort to assure that:

(1) System design is such that Logistic Support, manpower and skill requirements are not increased beyond the capabilities of presently assigned MOS personnel.

(2) RAM requirements are sufficiently high to assure that the Logistic Support burden will not be increased with the addition of the item to using unit TOEs.

d. Training Support Concept:

(1) The materiel developer, in coordination with the TRADOC proponent, will develop a detailed training subsystem capable of providing a complete transfer of knowledge from the developer to the system user and maintainer. This training subsystem will be based upon a precisely defined set of performance requirements obtained through analysis or collection of Logistic Support Analysis (LSA) data generated IAW DARCOM Pam 750-16 or MIL-M3035, as appropriate. Based on the results of this analysis, DARCOM/TRADOC will jointly agree upon a detailed task list covering all operator and maintenance difficult to train tasks for the system. The identification of and agreement on these tasks will be a formal, identifiable milestone in the validation phase of development. Tasks so identified will be incorporated into a signed agreement and into the system outline acquisition plan.

(2) TRADOC will describe the user population to the materiel developer and assist the materiel developer in identifying any unusual training requirements inherent in the intended user population.

(3) The DARCOM materiel developer will develop an outline of each TM to be produced, and preliminary draft documentation and storyboard training materials for tasks selected for training IAW approved Skill Performance Aids (SPAS) specifications. Deliverable products for DT/OT I will be determined between DARCOM and TRADOC on a case-by-case basis. The draft documentation and training produced as a result of this determination will be used to train operator/crew and maintenance personnel representative of the user population for OT I.

(4) The need for training requirements and materials, such as class room trainers or collective trainers, which are not identified as a result of the SPAS work effort, will be investigated. The necessary TRADOC/DARCOM responsibilities and resources to develop these training materials will be established and requirements will be included in the ROC or separate requirement documents, as appropriate.

(5) TRADOC will develop an outline individual and collective training plan (OICTP), outlining the initial system training concept and strategy and as much of the individual and collective unit and institutional training requirements as known.

(6) The capability of the player personnel, trained with the draft documentation and storyboard training materials, to perform the task selected for training to the required standards in the field phase of OT I will be made a critical test issue.

(7) The training support plan will be available for evaluation at OT I.

e. Personnel Support Plan. There are no personnel constraints related to mission area or force level. Introduction of this system will reduce the overall number of special purpose generators which will, in turn, decrease the annual maintenance man hours. This may result in some reduction of manpower requirements at the general support and depot support maintenance levels.

SCHEDULE & MILESTONES.

EVENT	FAMILY	SIZE (KILOWATTS (kW))			60	100	200
		1.5 kW	3	5	10/15	30	
a. LOA Approved	4QFY80	-	-	-	-	-	-
b. Outline Acquisition Plan (OAP)							
(1) Initiated	4QFY80	-	-	-	-	-	-
(2) Completed	4QFY81	-	-	-	-	-	-
c. Special IPR for OAP Approval	1QFY81	-	-	-	-	-	-
d. Advanced Dev							
(1) Initiated	4QFY79	1QFY81	1QFY81	1QFY83	1QFY81	1QFY83	1QFY84
(2) Completed	1QFY86	4QFY82	4QFY82	4QFY84	4QFY82	3QFY85	2QFY86
e. Concept Formulation Package							
(1) Initiated	1QFY81	1QFY81	1QFY81	1QFY83	4QFY80	1QFY81	1QFY84
(2) Completed	3QFY85	1QFY82	1QFY82	4QFY84	3QFY81	4QFY84	3QFY85
f. DT I/OT I							
(1) Initiated	3QFY80	3QFY82	1QFY84	1QFY84	2QFY82	1QFY83	3QFY85
(2) Completed	1QFY86	4QFY82	3QFY84	3QFY84	4QFY82	3QFY85	1QFY86
g. COEA							
(1) Initiated	4QFY80	4QFY81	3QFY83	3QFY83	2QFY81	4QFY82	3QFY85
(2) Completed	1QFY86	2QFY82	1QFY84	1QFY84	4QFY81	1QFY83	4QFY85
h. Acquisition Plan							
(1) Initiated	4QFY80	1QFY81	1QFY81	1QFY81	1QFY81	1QFY81	1QFY81
(2) Completed	2QFY86	4QFY82	3QFY82	4QFY84	1QFY82	4QFY83	2QFY86
i. VAL IPR	1QFY81-2QFY86	4QFY82	3QFY82	4QFY84	4QFY82	4QFY83	3QFY86

7. FUNDING: (\$000) Breakouts of funding by fiscal year and priority for each proposed family member in constant and then year dollars are attached as Annexes C & D respectively. The top three priority members can be accommodated with approved funding guidance.

a. ADVANCED DEVELOPMENT (6,3)

Range:

Constant (FY 80)	\$ 2964	\$ 6754
Inflated (Then Year)	\$ 3947	\$ 8994

Most Likely Funding Profile:	FY81	FY82	FY83	FY84	FY85	FY86	TOTAL
Approved Program (I)	505	633	323	--	--	--	1461
Constant (FY 80)	464	538	641	1250	1345	621	4859
Inflated (Then Year)	505	633	811	1690	1930	946	6515

Quantity of Prototypes: 1 preprototype plus 2 prototypes of each rating.

Sunk Costs (Excluded from Paragraph a): R&D (Actual) \$410 R&D (Constant) \$481

b. ENGINEERING DEVELOPMENT (6.4)

Range:

Constant (FY 80)	\$ 14088	\$ 28458
Inflated (Then Year)	\$ 22642	\$ 45738

Most Likely Funding Profile:	<u>FY83</u>	<u>FY84</u>	<u>FY85</u>	<u>FY86</u>	<u>FY87</u>	<u>FY88-90</u>	<u>TOTAL</u>
Approved Program (I)	891	2686	2795	1895	383	--	8650
Constant (FY 80)	704	1987	2771	3445	2011	7966	18884
Inflated (Then Year)	891	2686	3973	5240	3247	14314	30351

Quantity of Prototypes: 4 prototypes of each rating.

c. UNIT FLYAWAY COST (CONSTANT FY 80 DOLLARS)

<u>PRI</u>	<u>ITEM</u>	<u>UNIT COST (\$)</u>	<u>QUANTITY</u>	<u>LEARNING SLOPE (%)</u>
3	1.5	1,592	15000	86
4	3	2,684	10000	87
5	5	3,264	15000	88
1	10/15	14,338	5000	90
2	30	16,644	2500	91
6	60	23,982	600	92
7	100	38,107	500	94
8	200	60,514	100	96

NOTES: Source Document for cost is Abbreviated BCE, dated March 1979. Inflation has been incorporated in accordance with DARCOM Letter, DRCCP-ER, provided on 28 January 1980.

MERADCOM COST ANALYSIS DIVISION
CFCDC Control # 3202 Validation Level: II
7 Validated: 16 APR 80 Expires: 16 APR 81
Analyst: K.C.C. Phone # 444-72

FOR THE COMMANDER:

Carl Vuono

2 Incl CARL E. VUONO
1. Mission Profile Brigadier General, GS
2. Coordination Deputy Chief of Staff
Annex for Combat Developments

Edward W. Sedlacek
for STAN R. SHERIDAN
Major General, USA
Director of Development
and Engineering

ANNEX A
MISSION PROFILE

1. MISSION PROFILE:

a. WEAPONS POSING THREAT TO SYSTEM:

	<u>BDE</u>	<u>DIV</u>	<u>CORPS</u>	<u>REAR</u>
Small Arms	X			
Arty	X	X		
TAC AIR	X	X	X	X
Missile/Rocket	X	X	X	X

b. MISSION: Provide military units with conditioned electric power in required amounts and characteristics.

c. WEATHER EXTREMES: Climate categories 1-6. If supported equipment must operate in categories 7 or 8, protective shelter or kits may be provided.

d. TASKS:

(1) The function of electric power conditioners is to convert power for any period ranging from short intermittent periods to periods up to 24 hours per day for extended periods. Because solid state technology will be used in the power conditioners, and they will be electrically connected to a power source, tasking elements are expected to be based on that required for the power source. In this example, tasking is that required for tactical generators.

(2) <u>TASKS ELEMENTS</u>	<u>TIME</u>	<u>% OF TIME</u>
(a) Set up generator	15 min	1%
(b) Start generator	15 min	1%
(c) Operate at demand levels	21.5 hrs	90%
Full load	5 hrs	21%
75% load	6 hrs	25%
50% load	5 hrs	21%
25% load	4.5 hrs	19%
on line-0 load	1 hr	4%
(d) Shut down generator	15 min	1%
(e) Service time	30 min	2%
(f) Prepare for movement	15 min	1%
(g) Move to new site	1 hr	4%
MISSION TIME	24 hrs	

2. MOBILITY: System can be transported on vehicle types presently organic to units with no unacceptable degradation of the present mobility of those units.

3. OPERATING SUMMARY:

Conditioning Power - 89.5%

Not Conditioning Power - 10.5%

ANNEX B
COORDINATION ANNEX

Family of Military Electric Power Conditioners (PC)

Coordination with the following agencies has produced the following comments:

<u>AGENCY</u>	<u>CONCUR</u>	<u>COMMENTS RECEIVED</u>	<u>ACCEPTED</u>	<u>REJECTED</u>
HQDA (DAMO-RQ)	X	0	-	-
USAREUR & Seventh Army	X	0	-	-
USA Pacific Spt Gp	X	0	-	-
Eighth US Army	X	0	-	-
FORSCOM	X	0	-	-
DARCOM	X	0	-	-
Chief of Naval Operations	X	0	-	-
Chief of Naval Materiel	X	0	-	-
Comdt, USMC	X	0	-	-
Marine Corps Dev & Educ Comd	X	0	-	-
HQ, USAF	X	0	-	-
CDR, TAC	X	0	-	-
Health Sciences Command	X	0	-	-
British Army Staff	-	0	-	-
Canadian Forces Attaché (Land)	-	0	-	-
Australian Army Representative	X	0	-	-

ANNEX C

COST PROFILE (FY80 CONSTANT YEAR \$)

<u>CAT</u>	<u>PRI</u>	<u>RATING</u>	<u>FY81</u>	<u>FY82</u>	<u>FY83</u>	<u>FY84</u>	<u>FY85</u>	<u>FY86</u>	<u>FY87</u>	<u>FY88</u>	<u>FY89</u>	<u>FY90</u>
6.3	1	10/15	222	224								
	2	30	142	175								
	3	1.5	100	139								
TOTAL 6.3 APPROVED			464	538	255							
	4	3			141	283						
	5	5			151	303						
	6	60			94	403	223					
	7	100				110	473	262				
	8	200					151	649	359			
TOTAL 6.3 UNFUNDED					386	1250	1345	621				

6.4	1	10/15	317	748	974	227	237
	2	30		332	782	1019	
	3	1.5		907	193		
			<u>387</u>	<u>1987</u>	<u>1949</u>	<u>1246</u>	<u>237</u>
			<u>704</u>				
TOTAL 6.4 APPROVED							
	4	3			402	944	201
	5	5			420	986	210
	6	60				269	672
	7	100					317
	8	200					<u>374</u>
					<u>822</u>	<u>2199</u>	<u>1774</u>
TOTAL 6.4 UNFUNDDED							

MERADCOM COST ANALYSIS DIVISION

CRCDC Control # 3702 Validation Level: II
 Validated: 16 APR 80 Expires: 16 APR 81
 Analyst: KELLEY Phone # 446-772
 Supervisor: BUCHANAN Remarks: BUCHANAN

ANNEX D

COST PROFILE (THEN YEAR \$)

<u>CAT</u>	<u>PRI</u>	<u>RATING</u>	<u>FY81</u>	<u>FY82</u>	<u>FY83</u>	<u>FY84</u>	<u>FY85</u>	<u>FY86</u>	<u>FY87</u>	<u>FY88</u>	<u>FY89</u>	<u>FY90</u>
6.3	1	10/15	242	263								
	2	30	154	206	323							
	3	1.5	109	164								
TOTAL 6.3	APPROVED		505	633	323							
	4	3		178	383							
	5	5		191	410							
	6	60		119	545	320						
	7	100			149	678	399					
	8	200				204	931	547				
TOTAL 6.3	UNFUNDED			488	1691	1929	946					
	6.4	1	10/15		401	1011	1397	345				
	2	30				449	1121	1550	383			
	3	1.5				490	1226	277				
						891	2686	2795	1895	383		
TOTAL 6.4	APPROVED											
	4	3				576	1436	324				
	5	5				602	1500	339				
	6	60					409	1085	2117	929		
	7	100						512	1357	2650	1161	
	8	200							1601	3128	1371	
TOTAL 6.4	UNFUNDED					1178	3345	604	5075	6707	2532	

MERADCOM COST ANALYSIS DIVISION

CPDC Control #: 3701 Validation Level: II
 Validated: 10 APR 90 Expires: 10 APR 91
 Analyst: KELLEY Phone #: 447-1232
 Supervisor: Quinton P. Blount Remarks: _____

APPENDIX B POWER CONDITIONING EQUIPMENT QUESTIONNAIRE

1. Manufacturer's Name: _____

2. Description of Equipment:

3. Description of Technology Used (non-proprietary)

3.b. What are the major components used?

Electrical Output Specifications

4b. To what extent is a transient disturbance (e.g. voltage spike) on the input line attenuated or prevented from appearing on the output?

5. Load and Input Limitations

6.2. Ambient Conditions

Is equipment designed to field use by Army personnel in rough terrain?

6.c. What is the extent of vulnerability to external effects (e.g., electromagnetic and nuclear radiation?

7.2. Operation and Maintainability

Model Designation	Efficiency %	No Load Losses	Audible Noise	Reliability (Mean-time between failures in hrs.)	Operational Life at Rated Load	Maintainability (hours)
	FULL Load	3/4 Load	1/2 Load	(dB@ 6 ft)	(hrs)	Mean time to maintenance repair
1						
2						
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7.b. To what extent are established-reliability parts utilized?

7.6. To what extent is modular replacement used in maintenance?

7.d. What are the exceptions to total use of solid state components (e.g., electromechanical relays)?

1.8. Describe utilization of self-diagnostics and built-in test equipment.

8.1. Controls and Protective Features

8.b. To what electrical safety standards (e.g. NEMA, UL) does the equipment conform?

8.c. What meters and indicators are normally available?

9. Production

APPENDIX C



DEPARTMENT OF THE ARMY
US ARMY MOBILITY EQUIPMENT RESEARCH & DEVELOPMENT COMMAND
FORT BELVOIR, VIRGINIA 22000

January 18, 1983

DRDME-PEB

Gentlemen:

A survey of available commercial power conditioning equipment (e.g., inverters, converters or frequency changers) is being conducted to assess currently available technology in this field. The information will be used in planning an approved program to develop or adapt power conditioning equipment for U.S. Army field use. The survey is not limited to solid state equipment; all types of equipment, including rotating machinery (e.g., motor-generator sets) are to be considered.

You are invited to participate in this study by completing the enclosed questionnaire for each model of power conditioning equipment which you manufacture. Additional commercial literature would also be useful.

In order to meet our survey schedule, your response by 15 February 1983 will be appreciated.

The information is requested for planning purposes. The Government does not intend to award a contract on the basis of this request or otherwise pay for information solicited.

For additional information, please contact Dr. W. David Lee (703) 664-5724.

Sincerely,

A handwritten signature in black ink, appearing to read "H/B Rothschild".
Herb Rothschild
Contracting Officer

Enclosure



APPENDIX D

DEPARTMENT OF THE ARMY
US ARMY MOBILITY EQUIPMENT RESEARCH & DEVELOPMENT COMMAND
FORT BELVOIR, VIRGINIA 22060

DRDME- PM

8 December 1982

SUBJECT: Synopsis of Proposed Procurements

US Department of Commerce
Commerce Business Daily
P.O. Box 5999
Chicago, IL 60680

No. 27

US Army Mobility Equipment Research and Development Command, Procurement and Production Directorate, Fort Belvoir, VA 22060

A -- INFORMATION FOR USE IN PLANNING A DEVELOPMENT PROGRAM FOR MILITARY POWER CONDITIONING EQUIPMENT. Sources sought for manufacturers of power conditioning equipment of both solid state and rotating design (e.g., inverters, converters and frequency changers) to provide information via a questionnaire. The questionnaire requests data on cost, performance and availability of power conditioning equipment now on the market. Information will be used in planning a program to develop or adapt power conditioning equipment for Army field use.

THE GOVERNMENT DOES NOT INTEND TO AWARD A CONTRACT ON THE BASIS OF THIS REQUEST OR OTHERWISE PAY FOR THE INFORMATION SOLICITED. Interested firms are invited to submit information or data no later than 10 January 1983. U.S. Army MERADCOM, DRDME-PEA, Fort Belvoir, VA 22060. B. BALLINGER/(703) 664-5140.

12/14/82

NANCY S. VANNICE
Chief, Procurement Management Division
Procurement and Production Directorate

APPENDIX E

Abex-Jetway
3100 South Pennsylvania Ave.
Ogden, UT 84409

d.,e.

Aerospace Avionics Incorporated
Airport International Plaza
Bohemia, NY 11716

c.,e.

Airsupply Company
2690 Cumberland Parkway, Suite 460
Atlanta, GA 30339

c.

ALS Corporation
1400 N. Baxter Street
Anaheim, CA 92806

c.,e.

Alturdyne
8050 Armour Street
San Diego, CA 92111

a.,c.,d.,e.,h.

Arthur Wagner Company
1446 West Randolph Street
Chicago, IL 60607

c.,d.,e.

Atlas Energy Systems
9457 Rush Street
El Monte, CA 91733

c.

Avco Everett Research Laboratory, Inc.
2385 Revere Beach Parkway
Everett, Massachusetts 02149

c.

Avionic Instruments Incorporated
943 East Hazelwood Avenue
Rahway, NJ 07065

c.,d.,e.

Belyea Company, Incorporated
38 Howell Street
Jersey City, NJ 07306

c.,e.

Bendix Corporation
Electric Power Division
Eatontown, NJ 07724

c.,e.

Bogue Electric Manufacturing Company
102-T Pennsylvania Avenue
Paterson, NJ 07509

c.,e.

California Instruments
5150-T Convoy St.
San Diego, CA 92111

e.

OML Macarr, Incorporated
Sub. of Marine Electric R.P.D., Inc.
165 National Road
Edison, NJ 08817

c.,e.

Creative Technology, Incorporated
14415 N. Scottsdale Road
Scottsdale, AZ 85260

c.

CYBEREX
7171 Industrial Park Boulevard
Mentor, OH 44060

a.,c.,e.

Electronic Marketing Assoc, Inc.
(Representing Elgar, Dymarc, Oneac)
11716 Parklawn Drive
Rockville, MD 20852

a.,c.,e.

Elgar Corporation
8225 Mercury Court
San Diego, CA 92111

a.,c.

EMP Electronics, Inc.
1231 W. 23rd St
Tempe, AZ 85282

e.

Essex Electro Engineers, Incorporated
729 Thomas Drive
Bensenville, IL 60106

a.,c.

Exide Electronics
3301 Spring Forest Road
Raleigh, N.C. 27604

e.

Fermont Division
Dynamics Corporation of America
141 North Avenue
Bridgeport, CT 06606

c.,g.

Flite - Tronics Co., Inc.
2525 N. Naomi Street
Burbank, CA 91504

e.

Franklin Electric
Programmed Power Division
995 Benicia Avenue
Sunnyvale, CA 90509

c.,e.

Garrett Airesearch
Manufacturing Co.
2525 West 190th Street
Torrance, CA 90509

c.

General Electric Co.
Research & Development Center
P.O. Box 43
Schenectady, NY 12301

c.

GEORATOR
Attn: Mr. Jere Smith
9617 Center Stret
Manassas, VA 22110

c.,d.,e.

Good-All Electric, Company
Attn: Michael Hurd, Sales Mgr.
Government Products
3725 Canal Drive
Ft. Collins, CO 80524

a.,c.,d.,e.

Gould Deltec
Gould, Inc., Power Conversion Division
2727 Kurtz Street
San Diego, CA 92110

c.,e.

Helionetics, Inc.
Delta Electronic Control Corp. Div
17312 Eastman Street
Irvine, CA 92714

a.,c.,e.

Hughes Aircraft Co.
Electron Dynamics Div
3100 West Lomita Blvd.
Torrance, CA 90509

a.,c.

Industrial Systems, Incorporated
1121 Fresno
San Antonio, TX 78201

a.,c.

Introl Corporation
2314 East 8th Street
Los Angeles, CA 90021

a.,c.

Jet Electronics and Technology Inc.
5353 52nd St., S.E.
Grand Rapids, MI 49508

e.

KATO Engineering
Subsidiary of Reliance Electric
1467 First Avenue, North
Mankato, MN 56001

c.

MGS Electronics
2029 North Lincoln Ave.
Pasadena, CA 91103

e.

Kurtz & Root Company
P.O. Box 1119
Appleton, WI 54912

e.

Leland Electrosystems Inc.
P.O. Box 128
Vandalia, OH 45377

c.

Lockheed Missiles & Space Co., Inc.
Ocean Systems, San Diego
3929 Calle Fortunada
San Diego, CA 92123

c.

Louis Allis Company
Dept. TR
427 East Stewart Street
Milwaukee, WI 53201

c.

Martin Marietta Aerospace
P.O. Box 5837 MP508
ATTN: E. Warren Spahr
Tech Dir, R&D Elec Lab
Orlando, FL 32855

c.

Morse Industrial Products
Borg-Warner Corporation
6291 Barfield Road, Suite 102
Atlanta, GA 30328

c.

NOVA Electric Manufacturing Co.
263 Hillside Avenue
Nutley, NJ 07110

c.

Power Energy Industries
17115 Kingsview Avenue
Carson, CA 90746

c.,e.

Power Engineering
6879 Fashion Hills Blvd.
San Diego, CA 92111

c.

Powertronic Systems, Incorporated
P.O. Box 29109
New Orleans, LA 70189

c.,d.

Raytheon Company
Hartwell Road
Bedford, MA 01730

c.

Safety Electrical Equipment Corporation
26 Barnes Park Road, North
P.O. Box 798
Wallingford, CT 06492

c.

Simmonds Precision, Engine Systems
Norwich-Oxford Road
P.O. Box 310
Norwich, NY 13815

a.,c.

Tech Systems Corporation
Precise Power Systems Division
402 Watertown Road
Thomaston, CT 06787

c.

Teledyne Inet
2750 W. Lomita Blvd.
Torrance, CA 90509

a.,c.,d.,e.

Topaz Electronics Division
6291 Barfield Road, Suite 102
Atlanta, GA 30328

a.,e.,e.

United Technologies
Power Systems Division
P.O. Box 109
South Windsor, CT 06074

c.

Unitron Corporation
Attn: Mr. Chuck Sites
P.O. Box 2159
Garland, TX 75041

c.,d.,e.

VARO, Incorporated
Power Systems Division
2201 W. Walnut Street
P.O. Box 401267
Garland, TX 75040

a.,c.,e.

WER Industrial
3036 Alt. Boulevard
Dept. A
Grand Island, NY 14072

c.

Westinghouse Electric Corporation
P.O. Box 989
Lima, OH 45802

c.,d.,e.

William I. Horlick CO., Inc.
266 Summer Street
South Boston, MA 02210

c.

AEG Telefunken
Aussenstelle Koblenz 1
Rheinstr. 17
Postfach 107
D 5400 Koblenz 2
Attn: Mr. Schneider
Federal Republic of Germany

b.,c.

Allanson Manufacturing Company Limited
33 Cranfield Road
Toronto, Ontario, Canada
M4B 3H2

b.,c.

Brown Boveri Canada Inc.
Walter Flex Strasse 1
D 5300 Bonn 1
Attn: Mr. Dommermuth
Federal Republic of Germany

b.,c.

CEAG Licht and Stromversorgungstechnik GmbH
(for Brown, Boveri, Bonn)
Abt. MV2
4770 Soest - Postfach 78

d.

CTS of Canada Limited
80 Thomas Street
Streetsville, Ontario, Canada
L5M 1Y9

b.,c.,d.,e.

Cullen Detroit Diesel Allison Ltd
P.O. Box 82100
Burnaby, B.C., Canada V5C 5P6

h.

Delta Enterprises (Sarnia) Limited
P.O. Box 2049
177 Samuel Street
Sarnia, Ontario, Canada

b.,c.

Exide Canada Inc.
5200 Dixie Road, Unit 20
Mississauga, Ontario, Canada
L4W 1W2

b.,c.

Firma Benning
Muensterstr. 135
D 4290 Bucholt
Attn: Mr. Borkers
Federal Republic of Germany

b.,c.

Firma Industrie Automation
Am Unter Gruenen 6
D 7801 March - Buchheim
Attn: Mr. Kartscher
Federal Republic of Germany

b.,c.

Leroy Somer Canada Limited
337 rue Deslauriers
Montreal, Quebec, Canada
H4N 1W2

b.,c.

Mawdsley's LTD
Dursley
Gloucestershire GL 115AE England

d.,e.

Nife-Powertronics Corporation
125 Nantucket Blvd.
Scarborough, Ontario, Canada
M1P 2N8

b.,c.

Siemens AG
Abt. E 481
Postfach 3240
D 5820 Erlangen 2
Attn: Mr. Baum
Federal Republic of Germany

b.,c.

Staticon Limited
390 Tapscott Road, Unit 6
Scarborough, Ontario, Canada
M1B 2Y9

b.,c.

Telecom Power Corporation
2779 Lake City Way
Burnaby, British Columbia, Canada
V5A 2Z8

b.,c.

Willett Mfg. Company, a division of
A.C. Duce Electric Ltd.
P.O. Box 340
937 Eva Street
Estevan, Saskatchewan, Canada
S4A 2A4

b.,c.

Key to Appendix E

- a. Responded to CBD Solicitation
- b. Source obtained from Embassy or Liason office
- c. Letter of request, questionnaire sent to company
- d. Provided data via questionnaire
- e. Provided data sheets
- f. Returned to sender
- g. Responded, not presently in this field
- h. Furnished data on engine-generator sets only

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